R.S.

THE

RAY SOCIETY.

INSTITUTED MDCCCXLIV.

This volume is issued to the Subscribers to the RAY SOCIETY *for the Year* 1906.

LONDON:

MDCCCCVII.

Yours truly
Albany Hancock

THE BRITISH TUNICATA

AN UNFINISHED MONOGRAPH

BY THE LATE
JOSHUA ALDER

AND THE LATE
ALBANY HANCOCK, F.L.S.

EDITED BY
JOHN HOPKINSON, F.L.S., F.G.S., ETC.
Secretary of the Ray Society

VOLUME II

WITH LIVES OF THE AUTHORS
BY
CANON A. M. NORMAN, M.A., D.C.L., F.R.S.
AND THE LATE
DENNIS EMBLETON, M.D.

LONDON
PRINTED FOR THE RAY SOCIETY

1907

PRINTED BY ADLARD AND SON
LONDON AND DORKING.

UNIVERSITY OF ARIZONA
LIBRARY

596.2
A51
v.2

CONTENTS OF VOL. II.

PAGE

Life of Joshua Alder. By the Rev. Canon Norman, M.A., D.C.L., F.R.S., &c. xi

Life of Albany Hancock. By Dr. D. Embleton . . xvii

Addendum. By Canon Norman xxvii

Class Tunicata.

Order 1. Saccobranchiata.

Tribe 1. Solitariæ.

Family 1. Ascidiadæ (*continued*).

Genus 2. Ciona 1

„ 3. Corella 18

Family 2. Molgulidæ 34

Genus 4. Molgula 35

„ 5. Eugyra 65

Family 3. Cynthiadæ 75

Genus 6. Cynthia 75

„ 7. Styela 97

„ 8. Styelopsis 128

„ 9. Thylacium 135

„ 10. Pelonaia 139

Family 4. Clavelinidæ 147

Genus 11. Clavelina 148

„ 12. Perophora 155

„ 13. Diazona 159

Index of Species, etc., described 163

NOTE ON THE ILLUSTRATIONS.

All the plates in this volume (except the frontispiece) are photographic reproductions of original drawings by the authors—Plates XXV, XXVIII, XXXII, and L, by collotype, and all the rest by the half-tone process.

Plates XXI, XXVI, XXX, XXXIV, XXXVII, XXXVIII, XL, and XLIX are from drawings by Mr. Alder, and the figures are of the same size as drawn by him; the rest are from drawings by Mr. Hancock, and the figures are reduced in size, mostly to about one-half.

The figures in the text, with the exceptions of figs. 25–27, 48, 49, and 82–84, are reproduced by the half-tone process from drawings by Mr. Hancock, and nearly all are reduced in size. The figures excepted are photographic reproductions of published figures, 25 and 27 being reduced in size from the originals.

The Editor has arranged the figures and treated them in the same way as in Vol. I. He regrets that it has not been found possible to identify all Mr. Alder's figures, owing to the absence of descriptions of his completed plates.

JOHN HOPKINSON.

Weetwood, Watford,
30th November, 1906.

LIST OF THE PLATES.

PLATE

Portrait of Mr. Albany Hancock, from a photograph taken by Sir Joseph W. Swan, F.R.S., and reproduced by his permission *Frontispiece*

XXI.—Figs. 1–5.—*Ciona intestinalis.* Figs. 6–8.—*C. pulchella.* Fig. 9.—*Corella parallelogramma.*

XXII.—Figs. 1–8.—*Ciona fasciculatis.* Fig. 9.—*Corella larvæformis.* Figs. 10, 11.—*C. ovata.*

XXIII.—*Molgula conchilega :* details.

XXIV.—Figs. 1–6.—*Molgula complanata.* Figs. 7–10.—*M. oculata.*

XXV.—Fig. 1.—*Molgula valvata.* Figs. 2, 3.—*M. simplex.* Figs. 4–6.—*M. siphonata.*

XXVI.—Figs. 1–4.—*Molgula siphonata.* Figs. 5–9.—*M. citrina.* Figs. 10–12.—*Eugyra arenosa.*

XXVII.—Figs. 1, 2.—*Molgula socialis.* Figs. 3–5.—*M. inconspicua.* Figs. 6–8.—*M. citrina.*

XXVIII.—Figs. 1, 2.—*Molgula socialis.* Figs. 3–5.—*M. citrina.*

XXIX.—Figs. 1, 2.—*Eugyra arenosa.* Figs. 5–7.—*E. globosa.*

XXX.—Figs. 1, 2.—*Cynthia claudicans.* Fig. 3.—*C. squamulosa.* Figs. 4, 5.—*C. ovata.* Figs. 6, 7.—*C. morus.* Figs. 8, 9.—*C. tessellata.* Fig. 10.—*C. echinata.*

XXXI.—Figs. 1, 2.—*Cynthia rosea.* Figs. 3–5.—*C. claudicans.* Figs. 6–8.—*C. squamulosa.*

XXXII.—Figs. 1, 2.—*Cynthia squamulosa.* Figs. 3–5.—*C. ovata.* Figs. 6, 7.—*C. tessellata.* Fig. 8.—*C. echinata.*

XXXIII.—Fig. 1.—*Cynthia ovata.* Figs. 2–5.—*C. morus.* Figs. 6, 7.—*C. tessellata.*

XXXIV.—Figs. 1–5.—*Styela tuberosa.* Fig. 6.—*S. informis.* Figs. 7, 8.—*S. mamillaris.*

XXXV.—Fig. 1.—*Styela tuberosa.* Fig. 2.—*S. mamillaris.*

PLATE
XXXVI. Figs. 1–7.—*Styela tuberosa.* Figs. 8, 9.—*S. informis.*

XXXVII.—Figs. 1–4.—*Styela coriacea.* Fig. 5.—*S. pomaria.* Figs. 6, 7.—*S. sulcatula.* Figs. 8, 9.—*S. granulata.* Figs. 10–12.—*S. variabilis.* Fig. 13.—(?) *S. obscura.* Fig. 14.—*S. comata.* Fig. 15.—*S. vestita.* Figs. 16, 17.—*S. violacea.* Fig. 18.—*S. fibrillata.*

XXXVIII.—*Styela fibrillata.*

XXXIX.—Fig. 1.—A *Styela* (undescribed). Figs. 2, 3.—*S. coriacea.* Fig. 4.—*S. pomaria.* Figs. 5, 6.—*S. granulata.* Fig. 7.—*S. humilis.* Fig. 8.—*S. comata.* Fig. 9.—*S. vestita.* Figs. 10–12.—*S. violacea.* Figs. 13–16.—*S. depressa.* Fig. 17.—*S. northumbrica.*

XL.—Accessories, etc., of *Molgula siphonata* (figs. 1–3), *M. citrina* (fig. 4), *Eugyra arenosa* (fig. 5), *Cynthia claudicans* (fig. 6), *C. squamulosa* (fig. 7), *C. morus* (fig. 8), *Styela fibrillata* (fig. 9).

XLI.—Figs. 1–3.—*Styela mamillaris.* Figs. 4, 5.—*S. coriacea.*

XLII.—Figs. 1–7.—*Styela pomaria.* Figs. 8, 9.—*S. sulcatula.* Figs. 10, 11.—*S. granulata.*

XLIII.—Fig. 1.—*Styela variabilis.* Figs. 2, 3.—*S. comata.* Figs. 4, 5.—*S. vestita.*

XLIV.—Figs. 1–3.—*Styela fibrillata.* Figs. 4, 5.—*S. depressa.* Fig. 6.—*S. northumbrica.*

XLV.—Figs. 1, (?) 2.—*Styelopsis glomerata.* Figs. 3–5.—*Thylacium Normani.*

XLVI.—Figs. 1–4.—*Styelopsis grossularia.* Fig. 5.—*S. glomerata.* Figs. 6–8.—*Thylacium aggregatum.* Figs. 9–11.—*T. Sylvani.* Figs. 12–14.—*T. variolosum.* Figs. 15, 16.—*Pelonaia corrugata.*

XLVII.—*Pelonaia corrugata :* details.

XLVIII.—The branchial tubercle in *Molgula* (figs. 1–3), *Cynthia* (figs. 4–8), *Styela* (figs. 9–17), *Pelonaia* (fig. 18).

XLIX.—Figs. 1, 2.—*Clavelina lepadiformis.* Fig. 3.—*C. corrugata.* Figs. 4–6.—*Diazona violacea.*

L.—*Clavelina lepadiformis :* details.

ILLUSTRATIONS IN THE TEXT.

FIGS.		PAGE
25.	—*Tethyum fasciculatum* Bohadsch	6
26.	—*T. sociabile* Gunner	7
27.	—*Holothurium læve* Vandelli	8
28.	—*Ciona intestinalis :* mantle	13
29.	—*C. fascicularis :* tentacular filaments	16
30.	—*Corella parallelogramma :* part of branchial sac	20
31.	— „ „ biliary ducts	22
32.	— „ „ „ „	23
33.	— „ „ reproductive organs	24
34.	— „ „ male vesicle	25
35.	—*C. ovata :* part of branchial sac	33
36.	—*Molgula conchilega :* part of branchial sac	43
37.	—*M. complanata :* part of branchial sac	46
38, 39.	—*M. valvata :* test, two views	50
40.	—*M. simplex :* part of branchial sac	52
41.	— „ „ tentacular filament	52
42.	—*M. siphonata :* test	54
43.	— „ „ reproductive organs	56
44.	—*M. socialis :* part of branchial sac	57
45.	—*M. inconspicua :* part of branchial sac	60
46.	—*M. citrina :* reproductive organs	63
47.	— „ „ testicles	64
48, 49.	—*Eugyra arenosa :* parts of branchial sac	67
50.	—*Cynthia rosea :* mantle	77
51.	—*C. claudicans :* liver	80
52.	—*C. squamulosa :* „	80
53.	— „ „ tentacular filament	83
54.	—*C. ovata :* mantle	85
55.	— „ „ liver	88

FIGS.		PAGE
56.	—*C. morus :* liver	88
57.	—*C. tessellata :* oral tentacles	91
58.	—„ „ tentacular filament	91
59.	—*C. echinata :* „ „	95
60.	—*Styela tuberosa :* reproductive organs	101
61.	— „ „ ovaries	102
62.	—*S. informis :* tentacular filaments and branchial tubercle	105
63.	—*S. opalina :* test	109
64.	—*S. pomaria :* anal aperture	112
65.	—*S. granulata :* „ „	112
66.	—„ „ digestive and reproductive organs	116
67.	—*S. obscura :* tentacular filaments	119
68.	—„ „ digestive organs	119
69.	—„ „ anal aperture	119
70.	—*S. comata :* ovary	121
71.	—„ „ anal aperture	121
72.	—*S. vestita* „ „	121
73.	—„ „ test	122
74.	—„ „ tentacular filaments	123
75, 76.	—„ „ ovary, two views	124
77.	—*S. fibrillata :* ovaries	126
78.	—„ „ anal aperture	126
79.	—*S. northumbrica* „ „	126
80.	—„ „ reproductive organs	127
81.	—*Pelonaia corrugata :* part of branchial sac	141
82.	— „ „ test	147
83.	—*P. glabra :* test	147
84.	—„ „ anatomy	147
85, 86.	—*Perophora Listeri :* test, two views	156
87.	—A *Molgula*	162

LIFE OF JOSHUA ALDER.

Joshua Alder was born at Easter Eve, 1792, in Dean Street, Newcastle-upon-Tyne, where his father was in business as a provision merchant. At an early age he was sent to a school which was kept by two ladies in that town; and later was educated under his relative, the Rev. Joseph Simpson, at Tanfield School, where he was taught the rudiments of classics and mathematics.

"He appears to have been a lad of observation, vivacity, and humour. He was fond of sketching portraits and caricatures on the kitchen walls with a burnt stick, and of holding boyish dramatic performances with puppets, which he manufactured chiefly himself, and for which he pronounced the speeches, and thus, amid family gatherings of old and young, many a pleasant and joyous evening was spent. In the prosecution of these juvenile amusements we may observe the early evidence of his genial disposition, and the germs of those powers of observation and delineation which gradually grew up and developed themselves into talents of no mean order."*

At the age of fifteen Joshua Alder finally left school; and within a year his father died (November, 1808) and he at once commenced to assist his widowed mother in the business. It would not have been in accordance with his character if he had not done everything that he should have done in the matter of this business in the years which followed. But truly for business and money-making he had little taste: and in 1840, when 48 years of age, he retired into private life, and from that day living in quiet happiness with his devotedly attached sister, Miss Alder, he gave his time wholly to his favourite studies in Zoology.

*From "Notice of the Life of the late Joshua Alder, Esq., by D. Embleton, M. D." ('Nat. Hist. Trans. Northumberland and Durham,' Vol. I, 1867, p. 324) I am indebted to this memoir for information respecting Mr. Alder's early life; and passages which follow within inverted commas are from Dr. Embleton.

For it was at an early age that he had acquired an ardent love of Natural History. After leaving school he attended lectures, as a member of the Literary and Philosophical Society of Newcastle, on chemistry, electricity, and other branches of Physical Science. Moreover, the association with scientific men who became to him friends and companions shortly afterwards, could scarcely have failed to give a scientific bias to his mind. Among these associates were Thomas Bewick the famous wood-engraver, William Hutton the Palæontologist who made the famous 'Hutton Collection of Carboniferous Plants,' and George Burnett, who was a good Mineralogist.

It was not long before Alder began to take Natural History rambles in various directions around Newcastle in company with Thomas Hancock, a brother of Albany; W. Robertson, Botanist; and George Burnett, Mineralogist. In these excursions mineralogical and botanical specimens were collected. These short expeditions were soon extended in the summer months into longer pedestrian tours through the lake and mountain districts of Cumberland, Westmoreland, and the Scottish Lowlands. Now it was that there was added the collecting of land and freshwater shells to his earlier pursuits, and, finding great pleasure in hunting for them, he soon devoted himself exclusively to their study, which he subsequently extended to the entire molluscan fauna of our islands.

"About the year 1829 certain scientific men, among whom were Joshua Alder, William Hutton, Thomas, John, and Albany Hancock, William Hewetson (Ornithologist and Lepidopterist), George Wailes (Entomologist and Stained Glass Manufacturer, an art which I believe he was the first to revive), and the Rev. George Abbs (general Naturalist), conceived the idea that it would be at once pleasurable, profitable, and advantageous in all ways if they should meet together frequently, for the purpose of conversation and discussion on the several branches of Natural History to the study of which they were devoting their time. To this end they instituted '*Wednesday Evening Meetings*,' for such was the designation by which these friendly gatherings were known. They were held fortnightly at seven o'clock in the houses of the members in turn. All unnecessary expense was avoided, only a simple plain tea was given by the host, while two things were distinctly forbidden—discussion on political topics and the use of alcohol. Any discovery made by a member since the preceding meeting was communicated; specimens of interest

were exhibited, and conversation was for the most part confined to scientific subjects; and the meeting broke up about midnight. Naturalists who resided in neighbouring places, or who were passing through Newcastle, were frequently invited as guests; and as such a guest I was, when a young man, once present and enjoyed a delightful evening." *

A spirit of enthusiasm was naturally engendered by these meetings, as the members were continually acquiring knowledge and a more extended range of interest from companionship with those who were pursuing different paths through the fields of Natural Science. It cannot be wondered, therefore, that during the thirty following years in which the '*Wednesday Evening Meetings*' were held, and long afterwards, Newcastle was famous for that band of scientific citizens which was unequalled in any other provincial town.

In 1829 Alder was one of the founders of the Natural History Society of Northumberland and Durham, and he took a keen and active interest in the formation of its valuable Museum and acted as one of its Honorary Curators.

In 1831 there was published in the first volume of the 'Transactions of the Natural History Society of Northumberland and Durham' (Vol. I, pp. 26–41) Alder's first paper on Mollusca, "A Catalogue of Land and Freshwater Testaceous Mollusca found in the vicinity of Newcastle-upon-Tyne," to which a Supplement was added six years later (Vol. II, pp. 337–342). A French translation of the former was published by Férussac in his 'Bulletin des Sciences Naturelles, (Vol. XXVII, p. 195). This catalogue was the fullest local list of inland Mollusca which up to that time had been given. It contained 77 species, of which *Helix pura, radiatula,* and *granulata, Vertigo alpestris, Planorbis lævis,* and *Pisidium cinereum* were described as new.

Shortly after this time Alder turned his attention to the marine Mollusca, and his first paper in connection with these studies was published in 1841. His chief collecting-ground was the southern portion of the Northumberland coast, more especially Cullercoats, where the littoral zone was constantly explored, and satisfactory use made of the rejectamenta brought to shore in the boats of the long-line fishermen. In the summer months longer excursions were taken, when, always accompanied by Miss Alder, he visited each year some distant part of our shores. On the south-west coast he stayed at Torquay, Plymouth, Fowey, Falmouth, and Ilfracombe; on

* Norman, in President's Address, 'Report of Proceedings of the Museums Association,' Newcastle-upon-Tyne, 1895, p. 3.

the west coast at Swansea, Tenby, and Beaumaris; on the Scotch coast his investigations were carried on at Arran, Rothesay, Oban, and other localities; and he also visited Dublin. He delighted in fine scenery, and in addition to the Natural History spolia which he brought home from these expeditions, he always had numerous sketches in pencil of views which impressed him by their beauty. "Thus it was that, by undivided attention for many years to the systematic observation and collection of the different animals in their natural resorts, and by careful study and arrangement of them at home, he was enabled slowly but surely to develop and mature his talents, and to amass the large museum of British shells and zoophytes which was his pride, and one of the foundations of his fame as a Naturalist."

In 1842 the first publication on Nudibranchiate Mollusca under the joint names of Alder and Hancock appeared in the 'Annals and Magazine of Natural History'; and numerous papers followed in the same journal reporting fresh discoveries among these beautiful Mollusca. The 'Monograph of the British Nudibranchiate Mollusca' was published by the Ray Society during the years 1845 to 1855. This very fine work at once raised its authors into the first rank of Naturalists.*

In 1846 the Tyneside Naturalists' Field Club was founded, and Joshua Alder was one of its original Committee, and in 1849 was elected its President. The first volume of the Club's 'Transactions' contained his well-known "Catalogue of the Mollusca of Northumberland and Durham." This catalogue embraced 394 species, but amongst them were 30 species of Tunicata, in the examination and description of which he was joined by Albany Hancock.

After the completion of the Monograph on the Nudibranchiate Mollusca, Alder began to publish his papers on Zoophytes, the most important of which is "A Catalogue of the Zoophytes of Northumberland and Durham" ('Trans. Tyneside Nat. Field Club,' Vol. III, 1857) and its Supplement (Vol. V, 1863). Under the term Zoophyte at that time were included not only the Cœlenterata but also the Polyzoa, to both of which groups the author added many new species.

An account has already been given, at the commencement of the first volume of this work, of Alder's researches with respect to the Tunicata. A full list of his publications, fifty-three in number, will be found by those who may wish to consult it, at the end of his Life by Dr. Embleton.

* They left sufficient material for a Supplementary Part, which will shortly be published by the Ray Society.

"A great calamity, in which he had unfortunately many fellow-sufferers, befel him in 1857 in the failure of the Northumberland and Durham District Bank. By this he lost all his property, yet no one ever heard him complain; no word of blame or anger escaped him. He knew how to keep an even mind in adversity, as he had done in prosperity; and he was one of those few persons who have not had the extreme pain of being in adversity forsaken by their friends. A numerously and rapidly signed representation, containing the names of all our celebrities in science, and of troops of other friends, was made to the Government, who ultimately gave him from the Civil List a pension of £70 per annum." But material help came also from another quarter. Sir William (afterwards Lord) Armstrong consulted Alder's most intimate friends, and learnt that he had always purposed to bequeath his collections and library to the Newcastle Museum. Sir William then approached Alder through a friend with the intimation that he greatly desired to be allowed to purchase his collections and library in order that they might be placed in the Newcastle Museum after his death, and that he would be glad to secure this by the payment of an annuity during Alder's life. The annuity offered through the friend was a truly noble payment for the collection. It was a most kind act most delicately done.

Alder carried on extensive correspondence with brother Naturalists, and his letters were always most beautifully written and replete with information and interest when his help was asked for. In the earlier part of his career copious communications passed between him and Dr. George Johnston, Edward Forbes, William Thompson of Belfast, Cocks of Falmouth, and Dr. J. E. Grey, and also with the two Goodsirs, Hanley, Baird, Yarrell, Fleming, and Dr. Carpenter; also in later years with Allman, Busk, Hincks, Strethill Wright, Bowerbank, &c. Continental Naturalists who corresponded with him included Lovén, M. Sars, P. J. Van Beneden, H. Milne Edwards, Férussac, Dupuy, Phillipi, and Verany. He was always delighted to encourage and assist by any means in his power the less-informed Naturalists who sought his help. All work that he undertook evinced the greatest care and accuracy, while he possessed a most discriminating judgment in distinguishing species from varieties, so that perhaps no recent author has described so many species among marine Invertebrata with so few, if any, spurious species amongst them.

It was my good fortune to be able to pay him frequent

visits during the last nine years of his life, and he was deeply endeared to me, as indeed he was to all his intimate friends, by the beauty of his character. He was the thorough gentleman, courteous, honourable, and kind; a most delightful companion; so full of knowledge of his special subjects and of general information, yet so modest and humble withal; always bright and cheerful; a hasty or unkind word never escaped him with regard to another, for his was a truly benevolent mind.

During the latter years of his life his hearing partially failed, and the likeness which forms the frontispiece to the first volume of this work is admirable, and shows him in the position with hand to the ear which he assumed in conversation. It was taken by Sir Joseph W. Swan, F.R.S.

"His health, which had always been delicate, became during the latter years of his life gradually more and more infirm. He was afflicted with the painful consequences of prostatic disease, and within the last four or five years of his life had been on several occasions in imminent jeopardy; but owing to his previous careful living, by which he had avoided, as much as possible, all sources of disease, and husbanded the resources of his constitution, to the skilful surgical treatment of Dr. Gibb, and to the devoted and untiring care of his sister, to whom he was tenderly attached, he survived to be cut off by an attack of pleurisy, retaining his mental faculties, and manifesting his love of Natural History, up to within a few hours of his decease. His long and painful trials were borne with singular Christian patience, meekness, and philosophy."

So long as health permitted he had been a regular attendant and communicant at St. Nicholas Church, now the Cathedral of Newcastle. When seized with the attack of pleurisy, his sister at his request wrote to ask me to come and visit him ministerially. It was my privilege to do this and to administer to him the Holy Communion shortly before his death, which took place on the 21st of January, 1867, in the seventy-fifth year of his age.

His sister, whose chief thought in life had been the loving care of her brother, was never well subsequent to his death, but lingered on until the 7th of June, 1881, when she died at 85 years of age.

A. M. Norman.

LIFE OF ALBANY HANCOCK.*

Joshua Alder died in January, 1867, at the age of seventy-four years; Albany Hancock in October, 1873, at the age of sixty-seven years.

The linked names of Alder and Hancock, friends and fellow-workers for many years, will long be esteemed as those of good and true men, who, from a pure and unselfish love of science, have done much towards enlarging the boundaries of Natural History, and have shed a lustre on the town in which they were born and spent their lives. Both were self-taught men in their departments of scientific work, and have shown what talent and perseverance can effect without the aid of academic training. The same may be said in the case of many others of our distinguished men of the North of England.

In a memoir of the lives of men distinguished in any walk of life, or who have left their mark on any department of science, it is always interesting to know their origin, who and what their parents were, under whose auspices they were brought up, and whether or not their talents were hereditary.

Nothing is now known of the Hancock family before the time of Albany's grandfather, about the middle of the 18th century. His grandmother, whose maiden name was Baker, was, by the maternal side, a Henzell; a member of the family of that name, who, with the Tyzacks and Tytterys, brought to the Tyne and Wear, and also to Staffordshire, towards the end of the sixteenth century, the important art of glass-making.

Thomas Hancock, Albany's grandfather, was a saddler and ironmonger, at the north end of Tyne Bridge, before the year 1771. He had two sons, John and Henry. John, the elder, and the father of Albany, was sent to school at Rednire, in Yorkshire, under the Rev. T. Hislop, a clergyman of the Church of England. He showed much ability, and on leaving school joined his father in business. This he pursued

* Extracted, by permission of the Council of the Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne, from the 'Nat. Hist. Trans. of Northumberland and Durham,' Vol. V, pp. 118–134 (1877), with a few omissions.

more from principle than from love of it, for he used to say, when leaving his young companions for the shop, that he "was going to his duty."

When business was slack and the weather fine, he was in the habit of making, with two or three like-minded friends, trips on foot into various parts of these northern counties; spending the day in a delightful search after plants, insects, and shells, in the fields and woods, by the riversides, or on the rocky promontories and sandy beaches of the coast.

John Hancock and his friends were contemporary with Bewick, but worked in the departments of Botany, Entomology, and Conchology. What they gathered John Hancock studied, named, and arranged, and in a few years he had amassed a considerable collection, in which shells predominated. That he was in advance of his time as a devoted and successful student of Nature, this collection and his library demonstrate. The very best standard works of the day were his, and for a quiet provincial naturalist and tradesman, must have appeared extravagantly expensive. He also possessed one of the best microscopes of that day, and made much use of it.

He died at the comparatively early age of forty-three, in September, 1812, leaving a widow and six children, the eldest being eight years of age. Mrs. Hancock carefully treasured up the collections and books of her husband until her sons were old enough to value them. It was a day of surpassing interest, one which had been eagerly looked forward to, and which would never be forgotten by her children, when the cabinet and bookcase were formally opened for their admiration and use.

Albany, the third child and second son of John Hancock, was born on Christmas Eve, 1806, in the family house at the Bridge End. Losing the paternal example and guidance at the early age of six, he was, with his brothers and sisters, brought up by a tender and excellent mother, who succeeded in fostering their tastes and keeping alive the memory of their father. Of the six children, Albany, John, and Mary afterwards embraced the study of different branches of Natural History and the Fine Arts, but the exigencies of business compelled Thomas to relinquish his inclination for Geology. Thus four of the family appear to have inherited more or less a bias towards their father's studies.

Albany was sent early to the school of the Misses Prowitt, and afterwards to that of Mr. Henry Atkinson, both noted seminaries in Newcastle in those days. In the latter he remained about seven years. At the age of nineteen he was

indentured, and served as an articled clerk to Thomas Chater, Solicitor, of this town. At the end of his clerkship he studied at the office of Thomas Brown, Solicitor, in London, and was afterwards duly admitted as an Attorney. He returned to Newcastle in 1830, and the next year he took an office over the shop of his friend, Joshua Alder, in the Side. There he awaited practice for two years; but, attracted by the superior charms of Natural History, he quitted the office and the legal profession together.

He was one of the founders of the Natural History Society of Northumberland and Durham (the first part of whose 'Transactions' appeared in 1830), and an Honorary Curator of its Museum, to which, by his application and industry, he rendered essential assistance.

Letters left by him, dated 1832, 1833, and 1834, from Dr. W. S. Hooker of Glasgow, and Dr. Johnston of Berwick-upon-Tweed, show that he and his brother John had formed a project for a work on British Birds, which, not having been sufficiently encouraged, was dropped, though John had already executed some of the drawings for the work. [Some of these, however, were subsequently published in his "Catalogue of the Birds of Northumberland and Durham" ('Nat. Hist. Trans. Northumb. and Durham,' Vol. VI. 1874).]

From about 1835 to 1840 Albany had been turning his attention to modelling in clay and in plaster, and had accomplished a fair bust or two. He also designed and painted fish, flowers, and fruit, thus cultivating and improving the faculties and the tastes he was becoming more and more conscious of possessing, and preparing, without knowing it, for his future work. He delighted in beautiful and tasteful combinations of form and colour, and was a great admirer and good critic of Poetry and the Fine Arts generally.

Up to the age of thirty the subject of this memoir seems to have had no fixed object in life. He had withdrawn entirely from business, and indeed the simplicity of his habits and of his whole life made business of little interest to him, and the purity of his tastes and aspirations rendered work which had gain only for its object utterly distasteful to him.

Following the example of their father, Albany and his brothers Thomas and John, together with their friends, Joshua Alder, the Burnetts, William Hutton (joint author with Professor Lindley of 'The Fossil Flora'), William Robertson, R. B. Bowman, and John Thornhill, botanists, and W. C. Hewitson (author of 'The Eggs of British Birds,' and of 'Exotic Butterflies'), examined afresh the whole of the surrounding district, making collections of all natural objects.

These were the chief men who, with and after Bewick and his predecessors, gained for Newcastle its reputation for the successful prosecution of the study of Natural History.

Albany was one of the principal promoters of the Newcastle Polytechnic Exhibitions of 1840 and 1848, which gave a strong impetus to the diffusion of general information and a love of science among the public of the town and district; and for the acknowledged beauty of arrangement of these displays of art and science much was due to his taste and exertions.

From 1842 to 1864, in association with his friend Joshua Alder, he was engaged in the study of Conchology, and in the discovery of various new genera and species of Nudibranchiate Mollusca of the Northumberland Coast and other parts of the British Islands, and in the delineation and description of their external characters. Up to 1844 they had discovered and described two new genera and thirty-one new species (Rep. Brit. Assoc. for 1844 [p. 24]), though in the time of Linnæus only six species were known. In these and similar pursuits his powers of minute and accurate observation and correct description appear to have been successfully cultivated, and his talent for delineation by the pencil and brush fully exercised.

In 1843 Alder and Hancock published, in the 'Annals of Natural History,' "Observations on the Development of the Nudibranchiate Mollusks, with Remarks on their Structure."

About the time of the publication of this paper a change occurred in the direction of Albany's thoughts and studies, which influenced the whole of his future scientific career, and, by determining for him a fixed line of investigation, conduced to make him so distinguished an anatomist in Malacology that his views were afterwards justly regarded as of the highest authority in this department of science, and the most difficult points were at times submitted for his decision. The cause of this change it may not be uninteresting to Naturalists to relate. He had become convinced that valuable for classification as are the external characters and the habits of animals when carefully observed, it is absolutely necessary to investigate and understand their internal structure also, in order to form a correct idea of their physiology and of their proper arrangement according to their natural affinities.

In 1843 appeared an elaborate paper by M. de Quatrefages, afterwards a celebrated French Naturalist, in the 'Annales des Sciences Naturelles,' Vol. XIX, entitled "Mémoire sur l'Eolidine paradoxale." In order to estimate

duly the value of the work detailed in this memoir, it became necessary that the anatomy of the mollusk concerned should be investigated, and as I was at that time Lecturer on Anatomy and Physiology in the Newcastle School of Medicine, and was acquainted with Mr. Hancock's desires and difficulties, he requested me to join him in the investigation.

A few observations had already been made by Messrs. Alder and Hancock, and the latter had, with his usual acumen, detected some errors in the description of M. de Quatrefages. (See "Remarks on the Genus *Eolidina*, Quatrefages," in Ann. and Mag. Nat. Hist., XIV, 1844.)

M. de Quatrefages had stated that *Eolidina* possessed a heart and arteries, but no veins; that, therefore, the circulating apparatus was incomplete, the blood flowing to the heart through a series of open spaces in the areolar tissue of the body; that the mouth had no teeth; that the alimentary canal passing down the median line of the body ended in a dorsal anus, whilst there were given off on each side a symmetrical series of branches, equalling in number the dorsal papillæ, to each of which an offset was given, after which the branches ended in a narrow marginal canal running all round the body.

M. Milne Edwards had, in 1842, declared the existence of a similar appearance in *Calliopœa*, and had named it "a gastro-vascular system," believing that the digestive system, by its complexity, replaced in that animal the venous parts of the circulating system, and also the organs of respiration.

On dissecting in 1844 an *Eolis*, or *Eolidina*, taken at Cullercoats, we found that veins as well as arteries were present; that the mouth contained a spiny tongue; that the alimentary canal ended on the right side of the body, and that there was no marginal canal with which the branches from the stomach could communicate; that the branchial papillæ were the respiratory organs; that, therefore, the functions of digestion, circulation, and respiration, far from being performed by one system only (a gastro-vascular), had each its own special organ.

M. de Quatrefages, in 1844, communicated to the 'Annales des Sciences Naturelles,' ser. 3, Vol. I, p. 129, another memoir, in which he attempted, on the strength of his own previous observations and those of Milne Edwards, to establish a new order of Mollusks, to be called *Gasteropoda Phlebenterata*. In this memoir he stated that six genera of Mollusks possess a gastro-vascular system, and that, in fact, the three great functions of life — circulation, respiration, and digestion—are performed in them by one system only, thus degrad-

ing these Mollusks to the level of the Acephalous Medusæ; and he, moreover, attempted to lay down the vicious principle that the external characters of animals are altogether independent of, and are no key whatever to, their internal structure.

The theory of Phlebenterism, as it was called, was soon attacked, and shown to be false, by a rising young naval surgeon, M. de Souleyet, in a paper presented to the Académie des Sciences in 1844; and Naturalists in England, Germany, and Italy were astonished at the novelty and boldness of M. de Quatrefages' assertions. So important was the discussion considered by the savants of Paris that special commissions for the investigation of the new theory were appointed, by the Académie des Sciences in 1844, and by the Société de Biologie in 1849.

Both commissions having examined all producible evidence, including that from Newcastle, reported so diametrically against Phlebenterism, that the very name immediately afterwards disappeared from the language of science.

It was the interest in Anatomy and Physiology inspired by the discussion of this theory that determined Albany Hancock to pursue his researches into internal anatomy, whilst, at the same time, he paid due attention to external characters; and, having once got into the right track of research, he never looked back, but pursued the path which led him to honour and distinction.

We began with the regular study of *Eolis* in 1844, and in the following January the 'Annals and Magazine of Natural History' published the first part of the anatomy of this mollusk, in 1848 the second and third, and in 1849 the last part.

The investigation of *Doris*, another genus of Nudibranchs, was next undertaken: the results, embodied in a short summary, were communicated to the Edinburgh meeting of the British Association in 1850, and afterwards a paper "On the Anatomy of *Doris*" was read for us, in 1851, by Professor E. Forbes, to the Royal Society, and printed in the 'Philosophical Transactions' for 1852.

The above-mentioned papers on the anatomy of *Eolis* contained a more complete description of the organs, particularly those of the digestive, nervous, vascular, and reproductive systems, than had up to that time been given, and the degradation to which M. de Quatrefages had condemned those elegant mollusks was shown to be imaginary.

In the paper on *Doris* was announced the discovery of the existence in this, and in other closely allied mollusks, of the sympathetic or ganglionic system of nerves, and a nearly

complete description, with plates, of the extension of this system to all the viscera in *Doris* was given. Up to 1850 no sympathetic nervous system had been described in any animal below the Vertebrata, and it was, therefore, with peculiar pleasure and care that the ramifications of this system were traced out and laid down. Its presence in these creatures goes to show that the Mollusca are more closely related than the Articulata to the Vertebrata, and that, therefore, the transition from the Mollusca to these last is not quite so abrupt as has been believed.

During the period from 1845 to 1855 there appeared the justly celebrated 'Monograph of the British Nudibranchiate Mollusca, with figures of the species,' by Joshua Alder and Albany Hancock. This work, published by the Ray Society, soon gained for its authors a more than European reputation. The descriptions of external characters and the classification were the joint work of Alder and Hancock; most of the drawings of the species and the whole of those of the anatomy were by Hancock alone.

The beauty of the drawings and the delicacy of the colouring exhibited in this work it would be difficult to surpass, and the anatomical details are represented with a perfect fidelity to nature. Albany rapidly surmounted the difficulties attendant on the delicate dissection of microscopically-minute parts, in which the breath, even, has to be held and regulated, and the hand educated in the execution of the smallest possible movements; and he readily gained an extensive acquaintance with the principles and details of Comparative Anatomy.

The Tyneside Naturalists' Field Club was instituted in the year 1846, and one of its foremost and best supporters was Albany Hancock. The second paper in its 'Transactions,' that "On the Existence of *Limnoria terebrans* at the Mouth of the Tyne," was by him. He afterwards contributed papers "On the Boring Apparatus of the Carnivorous Gasteropods and of the Stone- and Wood-boring bivalves;" "On the Boring of the Mollusca, as *Teredo, Xylophaga, Pholas*, etc., into Rocks, etc.;" and "On the Excavating Powers of certain Sponges, as *Cliona*; with descriptions of several new species and an allied generic form." He continued his contributions to the 'Transactions' up to the year of his decease. On more than one occasion, and after much solicitation, he modestly declined the honour of being elected President of the Club.

After the completion of the Monograph of the Nudibranchiata he worked alone on "The Organization of the Brachiopoda," and his essay with this title, in the 'Philosophical

Transactions' for 1858, is a spendid proof of his talents as an enlightened Naturalist, a philosophical Anatomist, and an accomplished Artist.

The Royal Society, in acknowledgment of their appreciation of the high value of his works on the Mollusca, and of that on the Brachiopoda in particular, awarded him, in 1858, a Royal medal, an honour conferred on few.

In the Address of the President of that year (the Right Hon. Lord Wrottesly) at the Anniversary Meeting of the Royal Society, the following notice was taken of Albany Hancock's labours, on the presentation to him, through Prof. Huxley, of the Royal medal. After a commendatory notice of the papers on *Eolis* and *Doris*, the Monograph of the Nudibranchiata is characterized as "a work eminent alike for the beauty and fidelity of its illustrations and the value and completeness of its zoological and anatomical details." And further, "Among the more important of Mr. Hancock's numerous independent contributions to science should be noticed a valuable paper on the 'Excavating Powers of certain Sponges;' his discovery and accurate account of a new and curious genus of burrowing Cirripedes, and several others; in all of which is manifested a remarkable capacity for minute and accurate observation conjoined with great powers of generalization. But in none of Mr. Hancock's labours are these faculties so eminently displayed as in his more recent investigation of the organization of the Brachiopoda. In his elaborate monograph on this most difficult subject, and of which it may be truly said a more complete specimen of minute anatomy has not appeared since the days of Lyonet, a detailed account is given of the whole organization of the Brachiopoda founded upon the laborious dissection of numerous species; several interesting points in their economy, first indicated by Prof. Huxley, are confirmed; many additional facts communicated; and a new and clear light thrown upon the previously obscure subject of the physiological and systematic relations of the class in general."

Praise like this, and from so high a scientific source, could not but be agreeable to our friend, and stamped him as a man of established fame.

He was solicited to become a Fellow of the Royal Society, but declined the honour.

During the progress of the above works his attention was attracted from time to time by various subjects of kindred character, and he made numerous contributions to scientific periodicals; indeed, for thirty years, he scarcely ceased from work; each year bringing forth something of more or less solid

utility to his favourite sciences. He worked most perseveringly, taking little rest or relaxation and insufficient exercise; his patience and zeal were indefatigable; his observations were frequently repeated and tested; whilst his dissections were of necessity performed with the subject under water and by the aid of a lens, and at times required the use of the higher powers of a valuable microscope presented to him by Lady Armstrong. The drawings from his dissections were executed with a delicacy and minute correctness which left nothing to be desired, and the descriptions were always plain and modest, but conscientiously exact, his sole aim being the representation of the truth as it is in Nature. His sight was excellent, his powers of observation and manipulation now perfected, his generalizations enlightened, and, his mind having risen to its full development, he succeeded in unravelling the intricacies of the organization of the objects of his researches in so clear a manner as to call forth the admiration of those who, either in this country or abroad, had been educated to the study, and had held the highest places in the ranks of the cultivators of natural science.

During and after the year 1858 he produced numerous papers; with Mr. Alder on the Nudibranchiata, and also alone on the Cephalopoda, on the Freshwater Bryozoa, and on *Hydra*. In conjunction with Mr. Howse, in 1863, he classified and described, in the 'Transactions of the Zoological Society,' a collection of Indian Nudibranchs, sent by Walter Elliot, Esq. With Mr. Howse he contributed valuable papers on the Fossil Remains of the Marl-slate of Durham, and with Mr. Atthey various descriptions of the Fossil Fauna of the Northumberland Coalfield.

For these last additions to science the authors deserve high credit, and the thanks of all Palæontologists, for the lucid descriptions they have given of the remains of the ancient fishes and reptiles submitted to their investigation, and the satisfactory manner in which, with every modesty, they have cleared away a cloud of errors and hasty generalizations of previous writers, whereby the study of these interesting relics of a past Fauna had been rendered unnecessarily complicated and difficult.

We now come, lastly, to notice the work on the Tunicata. Mr. Hancock had, up to the autumn of 1873, completed about two-thirds, and a portion of the remainder. Ill health overtook him, and he deeply regretted that he was compelled to abandon the valuable work which he so much loved, and which he had so greatly illustrated, when he was within two years of the time when he expected to be able to bring it to a conclusion.

Slowly-increasing debility of frame, with dyspnœa and cough on exertion, rendered application to his work too onerous to be continued; even thought on the objects of his study could not be long kept up. Change of air and rest at Sir W. G. Armstrong's hospitable seat at Cragside benefited him from time to time, but he declined more and more through the summer and autumn, owing to dropsical symptoms supervening, and died tranquilly on the 24th of October, 1873, deeply regretted by all who knew his worth.

Albany Hancock kept up a correspondence with most of the leading Naturalists, as his numerous letters and presents of books and pamphlets testify; with Darwin, Owen, Huxley, Hooker, Sharpey, Forbes, Phillips, Allman, Busk, and several other distinguished Naturalists of Great Britain; with Cohen of Breslau; Suess of Vienna; Kelaart of Ceylon; Agassiz of the United States; Lacaze-Duthiers of Paris; Lovén of Stockholm; Bergh of Copenhagen; and others of the Continent of Europe.

He was not without special honours in his own country or from abroad. He was elected, in 1845, a corresponding member of the Manchester Natural History Society, and in 1862 a Fellow of the Linnean Society. In 1858, as already stated, he was awarded a Royal medal of the Royal Society of London, and declined the honour of the Fellowship. In 1865 he was elected a member of the Imperial and Royal Zoologico-Botanical Society of Vienna, and in 1869 a Correspondent of the Academy of Natural Sciences of Philadelphia, U. S. A., and particularly of the Conchological Section of that Academy.

He never betrayed the least vanity at being thus distinguished, but bore his honours meekly, and never alluded to his success; indeed he rarely mentioned it or his honours to anyone, and his diplomas were carefully put away, so as not to attract attention; but he failed not to experience within himself the natural gratification of finding that he had not worked in vain to extend the boundaries of human knowledge, and that his labours were appreciated by those who alone were competent to estimate their value.

Albany Hancock, gifted with a large and well-constituted brain, and trained, as few are, both as a lawyer and a close observer of Nature, was a person of philosophic mind; quick and accurate in perception, careful in weighing evidence, correct in judgment, careful and powerful in generalizing, and, withal, modest and unassuming. No one could be long in his genial company without feeling that he was in the presence of a superior person. He was fond of intellectual

society, which elicited his powers of mind, and in which he bore his part without assumption of superiority. He was not averse to argument, in which he always displayed large views, and an evident desire to arrive at a correct estimation of the matter under discussion; and his opinion once formed was firmly adhered to and difficult to shake. His great general information, his thoughtfulness and sound judgment, were well known, and in many cases of doubt or difficulty his decision was appealed to, with much advantage by others as well as by the members of his own family. Naturally mild, grave, and contemplative, he was courteous, sensitive, and somewhat diffident. He was kind and sympathizing towards the oppressed, and instances are not wanting in which his warm sympathy for his friends in misfortune or domestic affliction acted as balm to the wounded heart. There was benevolence in his smile and in his tear, and his conduct was marked throughout by purity and uprightness. Children he loved, and was beloved by them, though he was never married. He could partake of their simple joys and sorrows, and he was always ready to impart information and to teach them to observe with attention the objects around them.

His time was much occupied with his laborious researches and his study of authors on his favourite subjects, nevertheless he kept himself abreast of the current knowledge of the day, not only in Natural History, but in general Anatomy and Physiology, in Archæology, general Literature, and Politics, in all of which, and in the Fine Arts, he took especial pleasure.

The modesty and diffidence of his sensitive nature prevented him from taking part in discussions at public meetings, even on scientific subjects; and though he was solicited in 1850 to give a course of lectures on Zoology and Comparative Anatomy in the Newcastle College of Medicine, he modestly declined to undertake the task as one unfitted to his frame of mind.

DENNIS EMBLETON.

ADDENDUM.

Albany Hancock was a member of a talented family. He lived with a brother and two sisters, none of whom married. One of his sisters was a good painter in water-colours, while his brother John was preëminent as an Ornithologist, a Taxidermist, a Modeller, and a Landscape Gardener. The Newcastle Museum contains a very valuable collection of birds made and mounted by him most admirably in natural attitudes; while the wonderful rock-gardens of Lord Armstrong

at Cragside, and those at Jesmond Dene, Newcastle, were quite triumphs as showing what landscape gardening ought to be. It was John Hancock who was instrumental in raising through his many friends £39,000 with which to build that Museum which holds among other treasures his own collections, and which was opened by the Prince and Princess of Wales in July, 1884. John Hancock died on the 11th of October, 1890, in his 83rd year.

After the deaths of both Albany and John Hancock it was resolved that the Museum, which owed so much to the two brothers, should be named after them, and it is now known as the "Hancock Museum."

A "Hancock Prize" has also been instituted by which a small sum of money is given each year to the writer of the best paper giving an account of a day's Natural History excursion. Those only are allowed to compete who have not previously written anything of importance for the press, and the prize has done much to stimulate a love of Natural History amongst young men and young women in the two northern counties of Northumberland and Durham.

Alder and Hancock were Naturalists of a by-gone time. With only very moderate advantages as regards early education, they progressed greatly in knowledge by private study as years went by. An intense love of Nature absorbed them, and they realized that everything else must be sacrificed to allow them to find out Nature's secrets. They were not well off; with the little they had they were content; thought of marriage had to be given up, for Nature must be their spouse. Through the earlier part of the last century there were no University Science Schools, and few Professors of Natural History. Now a young man who has a taste for science can go through a thorough course of training in any branch of it he may desire, and after taking his degree may ultimately become a Professor. But this position is not without its disadvantages; the duties of the Professorial Chair take up so much time that little is left for special work. It is impossible to give anything like the years of study which Hancock devoted to the elucidation of the minute structure of some lower animals. On the other hand it is true that the modern physiologist can do much more in these days in a short time through the facilities which the use of chemical reagents and of the section-knife afford him.

A. M. Norman.

BRITISH TUNICATA.

Family I. Ascidiadæ (*continued*).

Genus 2. **CIONA** (Savigny) Fleming, 1828.

[*Ascidia* (pars) Linnæus Syst. Nat. ed. 12, I, pt. 2 (1767), p. 1087.]
Phallusiæ Cionæ Savigny Mém. Anim. sans Vert. pt. 2 [1816], p. 169.
Ciona Fleming Brit. Anim. [1828], p. 468; [Hancock in Ann. Nat. Hist. (4) VI (1870), p. 364].

Body subcylindrical, gelatinous, very contractile, attached more or less by the right side. *Apertures* terminal or nearly so, and not far apart; the branchial 8-lobed, the atrial* 6-lobed; with conspicuous ocelli. *Test* soft, smooth, and flaccid. *Mantle* with strong, longitudinal, muscular bands. *Tentacular filaments* numerous and slender, linear. *Branchial sac* elongated, [narrow,] not reaching to the bottom of the mantle; the meshes rectilinear with papillæ at the intersections. *Oral filaments* [replacing the lamina] numerous. *Stomach*, *intestine*, and *reproductive organs* extending below the branchial sac.

The genus *Ciona* may be distinguished from *Ascidia* by the softness and great contractility of the test, and by the stomach and intestine being situated below the branchial cavity, in this respect approaching to the

* The term "anal" used by the authors has in this volume been altered to "atrial" when it applies to the tube and its aperture by which the atrium communicates with the external medium.

relative position of these organs in *Clavelina* and the compound Ascidians. By this latter character *Ciona* seems to be related to *Pelonaia*, and also by the much elongated form of the branchial sac, and the position and proportions of the alimentary canal. It differs from both these genera [*Clavelina* and *Pelonaia*] by the oral lamina being replaced by a series of filaments.

The test of *Ciona* is not only characterized by its softness and contractility, but also by the facility with which it separates into layers, and by the fewness and indefiniteness of the vascular ramifications in its substance.

The mantle is remarkable for the arrangement of the muscular fibres, which are nearly as numerous on the one side of it as on the other. They are accumulated into ten stout, widely-separated, longitudinal bundles, which, originating at the base of the mantle, five on each side, extend upwards and pass into the walls of the respiratory tubes; three terminating in the inhalent, two in the exhalent tube. Delicate transverse fibres can also be traced the whole length of the mantle, particularly on the left side. The ocelli at the entrance of the respiratory tubes are very conspicuous.

The branchial sac is much elongated, and is composed of a simple rectangular reticulation of vessels; the primary or transverse channels being large and regularly disposed, the secondary minute and longitudinal. The longitudinal bars are stout, and have at the intersections very large, curved, tubercular processes.

The heart is also much modified. It lies in a fold of the lining membrane within what may be called the abdominal chamber, towards the dorsal margin, between the bottom of the branchial sac and the anterior or upper border of the stomach. It is in the form of a long tube, doubled upon itself, and is enclosed within a kind of pericardium, formed apparently by the lining (suspending) membrane. The looped or double portion

extends transversely into the centre of the chamber, and the extremities diverge in the direction of the dorsal margin, one passing upwards to the branchial sac, the other downwards to the pyloric end of the stomach. The upper extremity, as in *Ascidia*, divides into three branches, two of which supply the dorsal margin of the branchial sac, one upwards, the other downwards, forming the great dorsal branchial channel; the third supplies the test. The lower extremity of the heart divides in the usual way into two branches which ramify over the respective sides of the stomach. The stem which goes to the left side gives off a branch, which, turning backwards and upwards, goes along with its fellow from the upper end of the heart to the test. Another branch advances in the direction of the œsophagus, and is apparently the equivalent of that which goes to the ventral margin of the branchial sac in *Ascidia*.

Having thus far determined the circulatory organs, there can be little doubt that the blood-system is as complete in *Ciona* as it is in *Ascidia*, especially as traces of the visceral and pallial plexuses have been observed, and as the branchial suspenders are as largely developed as they are in that genus.

The digestive organs, as has been already stated, lie below the branchial sac; they are partially cut off from the rest of the body by a membrane. The œsophagus is considerably longer than it is in *Ascidia*, in this respect agreeing with *Pelonaia* and *Clavelina*. It is a rather wide tube, opening into the bottom of the branchial sac close to its ventral margin. From the oral orifice the œsophagus runs downwards, and then bending backwards joins the anterior end of a well-marked, globular, or ovate stomach, which lies across the bottom of the abdominal chamber. The intestine is a wide, even tube; it leaves the opposite or dorsal extremity of the stomach, and, bending upwards, crosses a little above that organ towards the right side of the body to the opposite or ventral margin, up

which it stretches in contact with the branchial sac, and on reaching the atrium it opens into it. In its course the intestine forms two wide loops. The rectal portion is long and the anal orifice is large, and has the margin reflected and reticulated, as is the case in *Pelonaia*.

The stomach and intestine have not a coating of vesicular matter like that observed in *Ascidia*, but a rudimentary hepatic organ can be observed.

The arrangement of the reproductive organs is rather peculiar. The ovary is a dense, elongated mass, lying against the right side of the stomach in the first loop of the intestine. It is infolded in a delicate transparent membrane which seems to be a duplicature of the lining membrane. This membrane also appears to be reflected over the alimentary tube and to fix it in its position like a peritoneum. The oviduct passes from the attenuated extremity of the ovary, proceeds towards the dorsal margin, runs upwards adherent to the intestine, and, ultimately becoming attached to the wall of the branchial sac, opens into the atrium a considerable way in advance of the anus. There is a small bulbous enlargement at the termination of the tube. The male secreting vesicles are very minute; they coat the lower portion of the intestine and the pyloric extremity of the stomach. The vas deferens is a delicate tube, which, passing between the stomach and the ovary, follows the oviduct to its termination, and there opens like it into the cloaca.

[Considerable difficulty has been experienced in working out the synonymy of the three species of *Ciona* described in this volume, and the references given may not all be correct. Some of the earlier descriptions are too meagre and the illustrations too inaccurate to definitely assign them to any one species, and in some cases the species intended to be represented by an author can only be inferred from the synonymy or references quoted by him.

The following, copied verbatim, is the synonymy

given by the authors of this monograph for *Ciona intestinalis*:—]

Ascidia intestinalis Linn. Syst. Nat. 12th ed. p. 1087; Müller Zool. Dan. Prod. 225; Bosc Vers, I, p. 107; Cuvier Mém. des Moll., Ascid. 23, t. 4–7; Lamarck Anim. s. Vert. 2nd ed. III, 533; Macg. Moll. Aberd. I, 31 [313]; Stark Elem. Nat. Hist. II, 117; Dalyell Rare and Rem. Anim. Scot. II, 142, t. 34, f. 4; For. and Hanl. Brit. Moll. I, 31; Ald. and Hanc. Trans. Tynes. Club, I, 199.
Ascidia corrugata Müller Zool. Dan. II, 54, t. 79, f. 3, 4.
Ascidia viridescens Brug. Enc. Méth. (Vers), I, 141 [152], t. 64, f. 4–6.
Phallusia intestinalis Savigny Mém. pt. 2, 169, t. 11, f. 1; Thompson Nat. Hist. Irel. IV, 361.
Ciona intestinalis Fleming Brit. Anim. 468.

[Linnæus defines *Ascidia intestinalis* as "*Ascidia lævis alba membranacea*," a description which is perhaps more applicable to *Ciona pulchella* than to *C. intestinalis*, and his references are:

Bohads. mar. 132, t. 10, f. 4; Baster subsc. 2, p. 84, t. 10, f. 5?; Act. nidros. 3, p. 81, t. 3, f. 3, 4.

Bohadsch's *Tethyum fasciculatum* (t. 10, f. 4) closely resembles Hancock's *Ciona fascicularis*. Copies of two of his figures reduced in size are given on p. 6 (fig. 25), the first being the one quoted by Linnæus. Baster's species (t. 10, f. 5) is usually referred to the *Ascidia ampulla* of Bruguière, and is most probably a *Cynthia*. "Act. nidros." refers to Gunner's paper on *Tethyum sociabile*. His figures (t. 3, ff. 3, 4) quoted by Linnæus are reproduced on p. 7 (fig. 26). It is very doubtful whether they represent *Ciona intestinalis*, and if they do not, this species as now understood is not that to which Linnæus gave the name *intestinalis*, and most of the earlier references on p. 9 under the name *Ascidia intestinalis* will fall.

Müller follows Linnæus in his 'Prodromus,' but omits the species, at least by this name, from the 'Zoologia Danica.'

Bosc quotes Bohadsch only; his species must therefore be relegated to *Ciona fasciculatis* or a near ally.

The reference of Müller's *Ascidia corrugata* to *Ciona intestinalis* is open to doubt.

The other references are probably correct. The *Ascidia viridescens* of the 'Encyclopédie Méthodique' is the "Sacanimal" of Dicquemare (1777).

The title of a work given in Dryander's 'Catalogue of the Banksian Library' (1796) led the Editor to the interesting discovery that *Ciona intestinalis* had been

Fig. 4.

Fig. 5.

Fig. 25.—*Tethyum fasciculatum* Bohadsch. ('Anim. Marin.' pl. x, figs. 4 and 5.) In fig. 4, *b* represents the "peduncles"; in fig. 5, *a a*, are young *Tethyi*; *b b*, "small fœtuses."

well described and figured between the dates of the 10th and 12th editions of the 'Systema Naturæ.' The title is "Vandelli, Dominicus. Epistola de Holothurio et Testudine coriacea. Patavii, 1761. 4°." Vandelli calls his holothurian "*Holothurium læve, dichotomum, fucis marinis alligatum.*" It is certainly the species now under consideration, as his figures, reproduced on p. 8 on a reduced scale (fig. 27), clearly show. They appear to be the earliest representations of the anatomy of a Tunicate, and are remarkably accurate for the time at which he wrote. Following the custom

of that time he called his essay a letter, and he addressed it to Linnæus, but although the work was printed six years before the 12th edition of the 'Systema' appeared, it is not referred to in that edition, nor is it in Gmelin's edition of 1791 ; indeed it appears to have been entirely overlooked by all subsequent writers with the exception of Dryander who correctly catalogued the work. Linnæus appears to have had a copy, for there is one in his library in the possession of the Linnean Society ; that in the Banksian Library is of course in the British Museum.

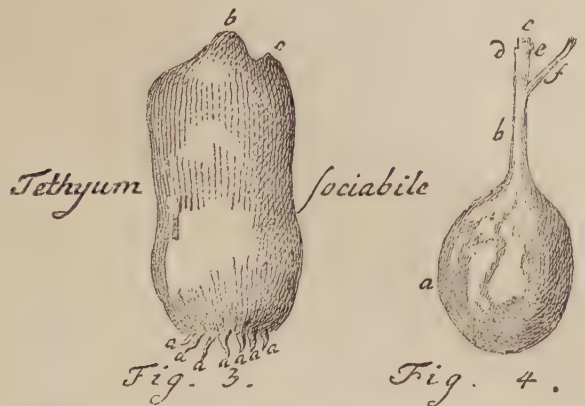


FIG. 26.—*Tethyum sociabile* Gunner. ('Trondhj. Selsk. Schrift.' III, pl. iii, figs. 3 and 4.) In fig. 3 (test), *a*, threads (of attachment) ; *b*, *c*, nipples (*worter*). In fig. 4 (mantle), *a*, belly ; *b*, neck ; *c*, mouth ; *d*, *e*, nipples or worts on each side of mouth ; *f*, anal tube ("*Kφr som gaaer op til* anus").

This is one of the earliest known Tunicates. It is the *Mentula marina* of Redi in his 'Osservazione . . . intorno agli Animali Viventi, che si trovano negli Animali Viventi,' p. 183, pl. xxi, f. 6 (Firenze, 1684), and it is almost certainly also Rondelet's "other species" of *Mentula marina* in his 'Universæ aquatilium Historiæ pars altera, cum veris ipsorum Imaginibus,' p. 129, fig. (Lugduni, 1555).

With regard to the other British species of *Ciona* which are described in the present work, it has been stated above that one, *C. fasciculatis* Hanc., closely

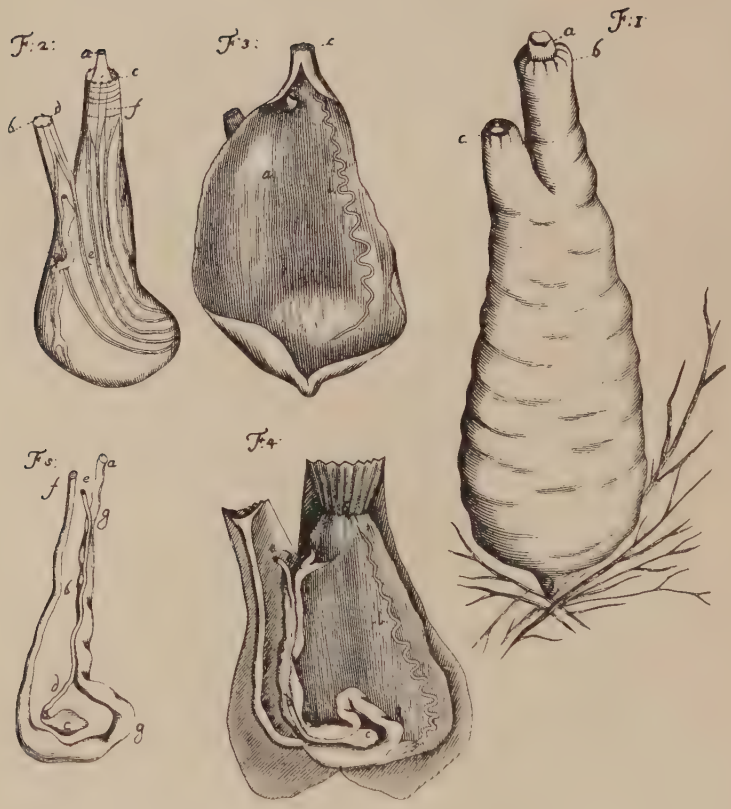


Fig. 27.—*Holothurium læve* Vandelli. ('Epist. de Holoth.,' pl. i.)

Fig. 1. *a*. tuba major.
b. fimbria.
c. tuba minor.
d. callosa prominentia.

Fig. 2. *a*. tuba major.
b. tuba minor.
c. puncta rubra.
d. puncta rubra.
e. fasciculus fibrarum, aus vasiculorum.
f. fibræ annulares.

Fig. 3. *a*. interna sacci cavitas.
c. tuba.
d. œsophagus.
e. intestina principium.
l. vasculum.

Fig. 4, 5. *a*. intestini pars, quæ e sacco exit.
b. an ovarium?
c. glandula.
d. vas album
e. punctum rubrum.
[*f*. tuba major. *g*. tuba minor.]
l. vasculum.

resembles *Tethyum fasciculatum* figured by Bohadsch in 1761; another, *C. pulchella* Alder, was figured by Blainville in 1827 as *Ascidia intestinalis*; and the remaining species, *Ciona canina* (Müll.), is described in this monograph as an *Ascidia* (see Vol. I, p. 122).]

1. **Ciona intestinalis** (Linnæus) Fleming.

(Plate I, figs. 1–5; and fig. 28 in text).

[*Holothurium læve* Vandelli De Holothurio (1761), p. 5, pl. i.]

[? *Tethyum sociabile* Gunner in Trondj. Selsk. Schrift. III (1765), pp. 81, 99, pl. iii, ff. 3, 4, and (German transl.) Dronth. Gess. Schrift. III (1767), pp. 69, 85, pl. iii, ff. 3, 4.]

Ascidia intestinalis Linnæus Syst. Nat. ed. 12 [I, pt. 2 (1767)], p. 1087 [*? pars*]; [P. Müller Linné vollst. Natursyst. I, 1 (1775), p. 85 (*non fig.*);] O. F. Müller Zool. Dan. Prodr. [1776], p. 225, no. 2733; [(?) Ellis & Solander Nat. Hist. Zooph. (1786), p. 49; Bruguière Hist. Nat. Vers, I (1789), p. 154 (*pars*), in Encycl. Méth.; Bory de St. Vincent Vers, etc. I (1791), p. 135, pl. lxiv, ff. 4–6 (*non* 1–3, 7), in Tabl. Encycl. Méth.; Gmelin Linnæi Syst. Nat. ed. 13, I, pt. 6 (1791), p. 3123 (*pars*);] Cuvier [Mém. Ascidies in Mém. du Mus. II (1815), p. 32, pl. ii, ff. 4–7;] Mém. Ascid. p. 23, pl. ii, ff. 4–7, in Mém. des Moll. [(1817); and Règne Anim. II (1817), p. 498; Duvernoy Ascid. in Dict. Sci. Nat. III (1816), p. 195 (*pars*); Lamarck Hist. Nat. Anim. sans Vert. ed. 1, III (1816), p. 126 (*pars*); Delle Chiaje Mem. Anim. senza Vert. III (1828), pp. 186, 199 (*pars*);] Stark Elem. Nat. Hist. II [1828], p. 117; [Rang Hist. nat. Moll. (1829), p. 352; Coldstream in Edinb. new Philos. Journ. IX (1830), p. 240; Gravenhorst Pergestina (1831), p. 41; Hoeven Handb. Dierk. II (1833), p. 33; Johnston in Mag. Nat. Hist. VI (1833), p. 242; Forbes & Goodsir in Rep. Brit. Assoc. for 1839 (1840), Sect. p. 80;] Lamarck Hist. Nat. Anim. sans Vert. ed 2, III [1840], p. 533 (*pars*); [Milne Edwards Obs. Asc. comp. in Mém. Acad. Sci. Inst. France, XVIII (1841), p. 228; De Kay Zool. New York, Moll. (1843), p. 259;] Macgillivray Moll. Anim. Aberdeen [1843], p. 313; Alder & Hancock in Trans. Tyneside Nat. Field Club, I [1848], p. 199;

Dalyell Rare Anim. Scotl. II [1848], p. 142, pl. xxxiv, ff. 4, 5; Forbes & Hanley Brit. Moll. I [1848], p. 31; [Cocks in Rep. R. Cornw. Polyt. Soc. for 1849 (1850), p. 73; Johnston Introd. Conch. (1850), p. 279; Rupert Jones in Cyclop. Anat. IV, pt. 40 (1850), pp. 1201–1211 *passim*: Forbes in Rep. Brit. Assoc. for 1850 (1851), p. 243; Norman in Zoologist, XV (1857), p. 5707; Chenu Encycl. Hist. Nat., Moll. etc. (1858), p. 246; Dickie in Rep. Brit. Assoc. for 1857 (1858), p. 111; Sars in Forh. Vid.-Selsk. Christ. 1858 (1859), p. 64; Bronn Thier-Reichs, III, 1 (1861), p. 121; Ansted & Latham Channel Isl. (1862), p. 219; Schultze in Zeits. f. wiss. Zool. XII, 2 (1862), p. 178; Alder in Nat. Hist. Trans. Northumb. Durh. I (1865), p. 11; Kowalevsky in Mém. Acad. Imp. Pétersb. (7) X, no. 15 (1866), pp. 3, 4, 11, pl. i–ii, ff. 1–27, and (abstr.) in Q. J. Micr. Sci. n.s. X (1870), p. 59; McIntosh in Proc. R. Soc. Edinb. VI (1866) p. 605; Wagner in Bull. Acad. Imp. Pétersb. X (1866), col. 402, fig.; Alder in Rep. Brit. Assoc. for 1866 (1867), p. 207; Norman in Rep. Brit. Assoc. for 1868 (1869), p. 302].

[?] *Ascidia corrugata* O. F. Müller [Zool. Dan. Prodr. (1776), p. 225, no. 2735; Zool. Dan. Descr. (1779), p. 118; Zool. Dan. Icon. II (1780), pl. lxxix, ff. 3, 4; and] Zool. Danica, II (1788), p. 54, pl. lxxix, ff. 3, 4; [Bruguière Hist. Nat. Vers. I (1789), p. 156, in Encycl. Méth.; Bory de St. Vincent Vers, etc. I (1791), p. 135, pl. lxiii, ff. 7, 8, in Tabl. Encycl. Méth.; Gmelin Linnæi Syst. Nat. ed. 13, I, pt. 6 (1791), p. 3126; Bosc Hist. Nat. Vers, I (1802), p. 105; Lamarck Hist. Anim. sans Vert. ed. 1, III (1816), p. 126, and ed. 2, III (1840), p. 533].

[*Sacanimal* Dicquemare in Obs. sur la Phys. (Journ. de Phys.), IX (1777), p. 137, pl. i, ff. 1–7.]

Ascidia viridescens Bruguière Hist. Nat. Vers, I [(1789), p. 152], in Encycl. Méth.; [Bosc Hist. Nat. Vers. I (1802), p. 106; Fleming in Edinb. Encycl. II (1811), p. 544].

Phallusia intestinalis Savigny [in Descr. Egypt., Hist. Nat. I (1809), pt. 2, p. 46, and] Mém. Anim. sans Vert. pt. 2 [1816], pp. 107, 115, 169 [*pars*], pl. xi, f. 1; [Fleming in Edinb. Encycl. XIV (1820), p. 631; Risso Hist. Nat. Europ. mérid. IV (1826), p. 275; Garner in Trans. Linn. Soc. Lond. XVII (1835), p. 485; Thompson in Ann. Nat. Hist. (1) V (1844), p. 95; Leunis Synops. Naturreiche, I, Zool. (1844), p. 412; Van Beneden Rech. Asc. simples, p. 20, in Mém. cour. Acad. Roy. Belg. XX (1846);]

Thompson Nat. Hist. Ireland, IV [1856], p. 361; [Bronn Thier-Reichs, III, 1 (1861), p. 154; Grube Mittheil. über St.Malo Meeres-fauna (1868), p. 7, and in Abh. Schles. Gesell. 1868–69 (1869), pp. 104, 125; Langsweert in Ann. Soc. Malac. Belg. III (1868), Mém. p. 115; Stepanoff in Bull. Acad. Imp. Pétersb. XIII (1869), col. 209].

[*Ascidia virescens* Pennant Brit. Zool. ed. 5, IV (1812), p. 99; Desmarest & Lesueur in Journ. de Phys. LXXX (1815), p. 426, pl. i, f. 14.]

[*Ascidia* sp. Schalck De Ascid. struct. (1814), with plate.]

[*Ciona Ascidia intestinalis* Fleming Philos. Zool. II (1822), p. 512.]

Ciona intestinalis Fleming Brit. Anim. [1828], p. 468; [Garner in Trans. Linn. Soc. Lond. XVII (1835), pl. xxiv, f. 1; Fleming Brit. Moll. (1837), p. 210, pl. xvi, f. 58; Hancock in Ann. Nat. Hist. (4) VI (1870), p. 364; Kupffer in Arch. f. mikr. Anat. VI (1870), p. 116].

[*Ascidia ocellata* L. Agassiz in Proc. Amer. Assoc. II (1850), p. 159.]

Body elongated, subcylindrical, flaccid, highly contractile, the upper parts retractile within the lower, greenish yellow (nearly white when young), attached more or less by the side or diagonally at the lower part. *Apertures* terminal, approximate, forming short tubes, their margins bright yellow, with red ocelli (Pl. XXI, fig. 4). *Test* soft, gelatinous, smooth, transparent, lax in texture and composed of distinct outer and inner layers. *Mantle* greenish yellow with strong longitudinal muscular bands which appear through the test. *Tentacular filaments* numerous, long, and slender. *Branchial sac* with broad, slightly-curved papillæ at the intersections. *Oral filaments* long.

Length three or four inches.

Hab.—On stones, at the roots of Algæ, and within old bivalve shells, ranging from between tide-marks to deep water.

Not uncommon on most parts of the British coast. [Especially abundant in the north (*Forbes & Hanley*).]

England.—[Coast of Northumberland and Dogger Bank (*Alder*, 1865). Harbour, Gwyllyn-vase, Swan-

pool, and Helford River, Falmouth, Cornwall (*Cocks*, 1849).]

Wales.—[Anglesey (*Pennant*, 1812).]

Scotland.—[Aberdeen (*Macgillivray*, 1843). North Uist, Outer Hebrides (*McIntosh*, 1866). "In Zetland seas" (*Fleming*, 1828). Orkney and Shetland (*Forbes & Goodsir*, 1839). West Voe, Whalsey Skerries, Shetland, at low water (*Norman*, 1868).]

Ireland.—[Strangford Lough, Down (*Thompson*, 1840).]

First record.—Fleming, 1828. [(?) Ellis & Solander, 1786. Pennant, 1812, as *Ascidia virescens*; *coll.* 1800.]

Ciona intestinalis is remarkable for the softness and great contractility of its test (Pl. XXI, figs. 1–3); when contracted the upper part is capable of being withdrawn within the lower part like the finger of a glove, and the latter is much shortened and thrown into transverse wrinkles. Usually it is extensively attached by the side, the anterior extremity being more or less free, so as to admit of its invagination. The vascularity of the test is confined to the lower part; the branches are not numerous and terminate in slightly enlarged, elliptical extremities.

The mantle (fig. 28) is remarkable for the strength of the longitudinal muscular bands which pass into the tubes and reach to the bottom of the pallial sac, where the component fibres are separated a little; the transverse fibres are very delicate and seem to be chiefly confined to the left side.

The branchial sac (Pl. XXI, fig. 5), like the body, is considerably elongated; it does not reach to the bottom of the mantle, though it overlies a little the left side of the first intestinal loop.

The stomach is a well-defined, ovate sac, lying transversely in the visceral chamber, the wide or œsophageal extremity towards the ventral margin. The œsophagus is a broad tube of some length; it turns immediately upwards from the stomach and opens into the bottom of the branchial sac at the ventral margin; the intestine

is wider than the œsophagus and is of equal calibre throughout; and in passing from the dorsal to the ventral margin it forms a deep sigmoidal curve, or two open loops, and then, turning upwards it advances, adherent to the ventral margin of the branchial sac for some distance, to the atrium, where it opens through a wide orifice with a reflected, denticulated margin.

The ovary lies suspended in a membrane within the

Fig. 28.—Mantle of *Ciona intestinalis*. Natural size. *v.t.* Blood-vessel leading to test.

first intestinal loop and at the right side of the stomach; it is an elongated clavate body with the thickened extremity curved; and the attenuated end turned towards the ventral margin. The oviduct is given off from this tapering extremity, and, accompanied by the vas deferens, it advances upwards by the left side of the intestine, opening into the upper portion of the atrium considerably in advance of the anal orifice; the extremity is enlarged into a small bulb. The male cæca are quite minute and are

spread over the lower portion of the intestine and stomach.

C. intestinalis is not uncommon in Finmark and the whole of the Norwegian coast, on stony ground in the Coralline and Laminarian zones, also in Greenland and North America (*Sars*).

2. **Ciona pulchella** (Alder).

(Plate I, figs. 6–8).

[*Ascidia intestinalis* Blainville Man. Malac. et Conch. (1825), p. 583 (1827), pl. lxxxii, f. 3; Cuvier Anim. Kingd. (transl. of ed. 2), III (1834), p. 114, and (1837), pl. xliii *ter.*, f. 2; Macgillivray Conch. Text-book (1845), p. 207, pl. xx, f. 7.]

Ascidia pulchella Alder in Ann. Nat. Hist. (3) XI [1863], p. 157; [(MS. sp.) in Ansted's Channel Isl. (1862), p. 219].

Body elongated, cylindrical, reddish, pale yellow, or hyaline white, attached by a rounded base, and capable of great retraction. *Apertures* tubular, terminal; the branchial much the longer, nearly one third the length of the body, and continuous in outline with it; the atrial about half as long as the branchial and a little narrower, projecting diagonally; both orifices with bright crimson ocelli. A deep impressed line runs from between the terminal tubes to nearly the base of the body. *Test* (Pl. XXI, figs. 6 and 7) soft, smooth, hyaline, and transparent. *Mantle* (Pl. XXI, fig. 8) yellowish, passing to red above, or sometimes colourless, with longitudinal muscular bands narrower than in *C. intestinalis*. *Tentacular filaments* [stout (*Alder, l. c.*)]. *Branchial sac* with rather broad papillæ.

Length an inch or a little more.

Hab.—[Below low water-mark.]

England.—Salcombe Bay, Devon (*Hincks*). Fowey Harbour, Cornwall (*Peach*).

Channel Islands.—Guernsey, dredged (*Norman*).

First record.—Alder, 1863.

This pretty species comes very near to *Ciona intesti-*

nalis, from which it differs in size and colour [being much smaller and never tinged with green]; but more especially in the [greater] length of the tubular orifices, which project considerably beyond the body when extended. Not having had an opportunity of seeing it in a living state, we are indebted to Mr. Peach for the drawing from which the accompanying figures are taken, and to Mr. Hincks for some of the details.

3. **Ciona fascicularis** Hancock.

(Plate II, figs. 1–8; and fig. 29 in text.)

[? *Tethyum fasciculatum* Bohadsch Anim. Marin. (1761), p. 132, pl. x, ff. 4–6.]
[? *Ascidia intestinalis* Linnæus Syst. Nat. ed. 12, I (1767), pt. 2, p. 1087 (*pars*); Bosc Hist. Nat. Vers, I (1802), p. 107; Barbut Gen. Verm. (1783), p. 50, pl. v, f. 3.]
Ciona fascicularis Hancock in Ann. Nat. Hist. [(4) VI (1870), p. 364].

Body much elongated, sub-cylindrical, flaccid, highly contractile, colourless, or tinged yellowish from the mantle and viscera appearing through it; attached by the side of the base; the lower extremity with numerous, rather long cylindrical papillæ. *Apertures* tubular, short, yellowish, with red ocelli; the branchial terminal, the atrial at a short distance down the ventral margin. *Test* soft, smooth, gelatinous, perfectly hyaline. *Mantle* delicate, pale yellow, and extremely transparent, all the visceral organs being distinctly seen through it; tubes short, cylindrical, and more highly coloured than the rest of the mantle. *Branchial sac* long, narrow, cylindrical, with rather long papillæ, non-plicate. *Oral filaments* long, slender, numerous. *Tentacular filaments* numerous, long and slender, with short intermediate ones, set in a single row on a narrow scalloped fold or collar.

Length from two to three inches; *breadth* [nearly] half an inch.

Hab.—(?).

Ireland. — Kilkieran Bay, Connemara, Galway (*More*).

First record.—Hancock, 1870; *coll.* More, 1869.

The body of this very distinct species is much elongated and almost cylindrical; it tapers, however, slightly to the branchial tube, which is not much produced and is exactly terminal. At the inferior extremity it is a little enlarged or clavate. The test

Fig. 29.—Tentacles of *Ciona fasciculatis*. Highly magnified.

(Pl. XXII, fig. 1) is so perfectly transparent that the reticulations of the branchial sac are visible through it. The atrial tube is placed a short way down the ventral margin, and is only slightly produced. The lower enlarged extremity is rounded, and for a little way up is covered with numerous, rather long, cylindrical papillæ; the rest of the surface is perfectly smooth and is very soft throughout; it is quite devoid of colour except at the apertures, which are slightly tinged with yellow, and the viscera impart a yellow hue, particularly to the lower part. The vascular ramifications are confined to the inferior extremity, and penetrate the external papillæ.

The mantle (Pl. XXII, figs. 2–4) is excessively delicate, very transparent, and tinged slightly with

yellow, or nearly colourless. The longitudinal muscular bands are extremely delicate, so much so that it is difficult to trace them; they extend, however, into the tubes and reach to the bottom of the pallial sac, where the fibres are a little diffused.

The branchial sac (Pl. XXII, fig. 5) is extremely elongated and nearly cylindrical; the primary vessels are very regularly disposed, the larger ones having three or four smaller between them. The oral filaments are long, slender above, and widened a little at the base; they correspond in number to the large primary vessels. The branchial tubercle is small and transversely oval. The tentacular filaments (Pl. XXII, fig. 8, and fig. 29 in text) are arranged on a narrow undulated fold or collar; they are long and slender with intermediate short ones; in all about seventy. They are quite colourless.

The alimentary tube is disposed much in the same manner as it is in *C. intestinalis*, only it is more decidedly pendant, as it were, from the branchial sac; and the stomach, instead of being placed across the visceral chamber, hangs downwards; the œsophagus, which is rather long and narrow, enters it above, and the intestine leaves it below; it is well marked and is pretty-regularly oval. The intestine sinks to the bottom of the mantle, and then, turning upwards and backwards, forms a short open loop; it crosses over on the right side of the stomach in a sigmoidal curve, and on reaching the ventral margin passes up by the side of the branchial sac to the lower end of the atrium, terminating about one third up the body. The margin of the anal opening is lobed and reflected.

The ovary is placed in the intestinal loop on the right of the stomach; it is an elongated, somewhat clavate mass, with the oviduct passing from the attenuated extremity. The genital outlets are placed high up in the atrium, not much below the atrial tube and considerably in advance of the anal orifice; two canals end in a compound nipple with a double outlet, or rather, in two minute nipples placed side by side.

For specimens of this very distinct and interesting species we are indebted to Mr. A. G. More, who collected it in considerable abundance in Kilkieran Bay, Connemara, in 1869. The specimens were for the most part united towards the base into dense clusters, the upper portions being quite free. The aggregation is produced by the agency of the papillæ, which clothe the sides of the basal extremity of the test; the attachment is consequently lateral. The common mass had apparently been fixed by the same means to some foreign body.

Genus 3. **CORELLA** Alder & Hancock, 1870.

[*Ascidia* (pars) O. F. Müller Zool. Danica, II (1788), p. 11.]
[*Phallusia* Murray in Proc. R. Soc. Edinb. IV (1859), p. 149.]
Corella Alder & Hancock in Ann. Nat. Hist. [(4) VI (1870), p. 362].

Body subquadrate, rounded, or ovate, coriaceous, very slightly contractile, rather compressed, attached mostly by the base. *Apertures* as in *Ascidia*, the branchial 8-lobed, the atrial 6-lobed, each with small ocelli. *Test* smooth and diaphanous. *Mantle* often brightly coloured. *Tentacular filaments* linear, unbranched. *Branchial sac* with the meshes regularly and beautifully convoluted, framed in squares formed by stout, secondary rectilinear vessels and the primary transverse vessels. *Viscera* sinistral, the stomach placed low, with the intestine bending backwards and downwards on the left side, passing along the base of the mantle, and rising in front to the anal aperture. *Reproductive organs* on both sides, the oviduct following the line of the intestine.

The above genus was characterized when only a single species was known, namely the so-called *Ascidia parallelogramma*, which differs in so many important characters from the species with which it was associ-

ated that we deemed it right to make the change. Since then two other very interesting species have been discovered which agree in all essential characters with this type; thus in a measure justifying the establishment of the genus, the members of which are all sinistral. The alimentary tube is very differently disposed from that of *Ascidia*; the heart occupies a different position, and the spiral arrangement of the secondary branchial vessels seems alone sufficient to distinguish the genus.

As the internal organization is very similar in all the three species, we will confine the following description of it to that of *C. parallelogramma*, which we consider the type form. This animal is scarcely more remarkable for its internal organization than it is for the brilliant colouring of its mantle, and for the smoothness, transparency, and glossiness of its test, which is thin and only slightly, if at all, contractile, but possesses considerable elasticity.

The inner tunic or mantle is delicate, thin, and transparent, though usually highly coloured. It is deficiently supplied with muscular fibres, which are arranged, for the most part, near the margin in a radiating manner, the bundles being slender and far apart. This is the case with the right side; the left is almost deprived of muscles, there being only a few scattered, delicate fibres at the base of the inhalant tube, placed longitudinally. The respiratory tubes themselves are sparingly supplied with a few feeble, delicate, circular and longitudinal fibres.

The branchial sac (fig. 30) is comparatively short, and is sub-quadrate in form. It reaches to the bottom of the pallial chamber, the posterior extremity passing on the right of the digestive organs. The whole aerating surface presents a rather coarse rectangular reticulation, formed by the primary transverse vessels, and containing almost equally stout, longitudinal secondary vessels. The square meshes so formed are in transverse series, and are filled up with pretty-regular

spirals composed of minute secondary vessels. Thus each spiral coil is set, as it were, in a square frame, and forms a slightly-conical eminence which projects a little into the branchial cavity. A few radiating vessels pass from the apex of each cone to the points where the transverse channels are intersected by the secondary rectilinear vessels. Thus there are usually four such radiating vessels to each coil. The longitudinal bars are rigid and cord-like; they project considerably from the surface of the gill. The papillary membranes

Fig. 30.—Part of the branchial sac of *Corella parallelogramma*. Much enlarged.

are ample, extending from bar to bar, and have the free margin considerably thickened, as is the case in *Ascidia scabra*. In *Corella*, as in *Ascidia*, there are no branchial papillæ properly so-called; but the thickened edge of the membrane projecting from the bars occasionally becomes assimilated to papillæ.

The oral lamina is replaced by a series of well-developed filamentous processes, which are wide at the base and taper to fine points; they extend from the top of the branchial sac and terminate near its

bottom at the right side of the mouth. These, the oral papillæ, agree in number with the transverse rows of spirals, or rather with the primary vessels which divide them. The branchial tubercle is large and very little complicated in its structure. It is in the form of a simple loop, with its right extremity projecting upwards considerably above the other, which is turned inwards. The endostyle reaches from one end of the sac to the other. Both the anterior and posterior cords in connexion with its extremities are well developed. The tentacular filaments at the base of the inhalant tube are numerous, long, delicate, and simple ; they are nearly of uniform size. The nervous ganglion is minute, and is of the usual elongated form. The nerves, which cannot be traced very far, go to supply the mantle or inner tunic and the respiratory tubes.

The heart, unlike that of *Ascidia*, is stretched along the anterior border of the stomach, and lies within a pericardial chamber which is situated in the thickness of the mantle or inner tunic on the left side of the branchial sac. From the dorsal extremity of the organ a branch is given off which divides immediately into two branches, one of which passes upwards, the other downwards in connection with the endostyle, and both go to form the great dorsal, branchial sinus or channel. Another branch also leaves this extremity of the heart and becomes at once associated with a branch of equal size which seems to come from the right-hand side of the stomach. These two vessels thus associated pass into the test within which they ramify. From the ventral extremity of the heart a vessel is apparently given off to each side of the cardiac end of the stomach. Further than this the blood-system has not been traced, though there is no reason to suppose that it differs in any important respect from that of *Ascidia*.

The digestive system is considerably modified. The mouth is large and circular, with a wide fleshy lip or

rim open in front. The œsophagus is distinctly marked; it is a rather short constricted tube stretching from the ventral or anterior extremity of the stomach, which is a large elliptical organ, somewhat laterally compressed, lying transversely near to the bottom of the pallial cavity, to the left wall of which it is adherent. The posterior extremity of the branchial sac overlies the right side of the stomach. The intestine at its origin is nearly as wide as the stomach; it passes from the dorsal end of that organ, and, bending

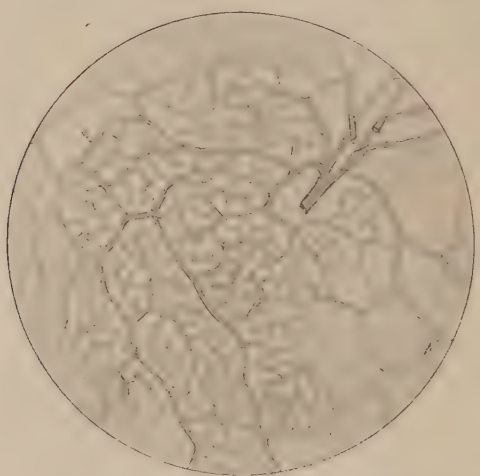


Fig. 31.—Biliary ducts in *Corella parallelogramma*. × about 30. (Reduced one-half from drawing made with 1 inch object-glass.)

backwards and downwards, courses along the lower margin of the stomach at the bottom of the pallial chamber; it then passes up the ventral margin in a straight line adherent to the branchial sac until it reaches the cloaca situated at the base of the exhalant tube, where, contracting a little, it terminates. The anal orifice is bordered with a smooth, wide, reflected, lobed rim.

The mucous membrane lining the stomach is thick and is thrown into strong, mostly longitudinal wrinkles, which are arranged with some degree of regularity.

On account of the transparency of the outer wall, these folds of the lining membrane are distinctly displayed externally, and give quite an ornamental appearance to the organ. The mucous membrane of the œsophagus is also longitudinally folded; that of the intestine is not so.

The hepatic organ (figs. 31 and 32), like the rest of the digestive system, is also remarkably modified. The ultimate structure of the liver is composed of a minute network of anastomosing tubes spread over the

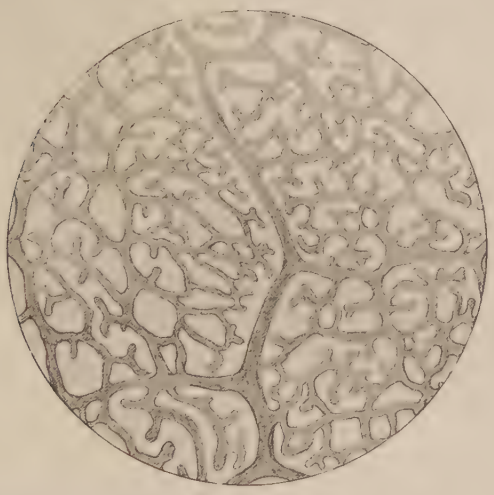


Fig. 32.—Biliary ducts in *Corella parallelogramma*. × about 60. (Reduced one-half from drawing made with ½ inch object-glass.)

outer surface of the intestine, the interstitial meshes being filled up with still more minute anastomosing and branched tubes forming as many systems, the ultimate (terminal) twigs of which end in blind sacs, occasionally a little enlarged and rounded, and sometimes bifid. The main branches leading from the network exhibit a tendency to divide dichotomously, and unite to form two slender ducts which pass at once from the intestine to the left side and close to the posterior margin of the stomach, into which they

pour the biliary secretion a little in advance of the pylorus.

The reproductive organs (fig. 33) are spread over both sides of the digestive tube. The ovary is a

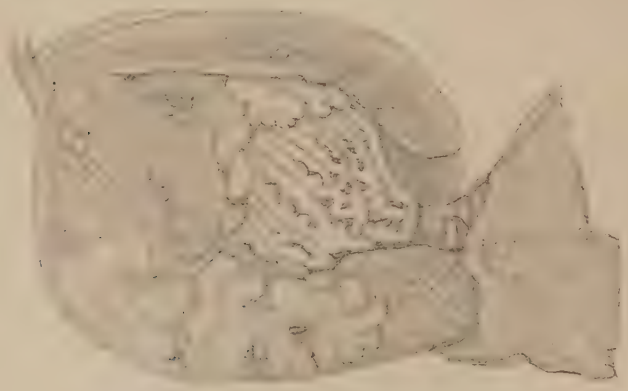


Fig. 33.—Reproductive organs in *Corella parallelogramma*. Magnified.

branched and lobulated organ, most profusely distributed over the right side of the pyloric extremity of the stomach and the looped portion of the intestine;

Fig. 34.—Male vesicle in *Corella parallelogramma*. More highly magnified. *a*. Tube leading to vas deferens.

a few dendritic branches only are seen on the left side of these organs. The oviduct is a long, rather slender tube; it passes through the loop formed by the doubling of the intestine, to the left side, and then,

running forward in contact with the lower margin of the stomach, it passes upwards attached to the left side of the intestine, and opens into the cloaca close by the anal tube. The male secreting vesicles (fig. 34) are much larger than usual and are spread over both sides of the stomach and intestine associated with the ovary. They are elongated, branched, and irregular in form; showing a disposition to dichotomous division; and are combined into dendritic clusters or systems from which extremely delicate tubes pass off that unite and go to form the vas deferens, which accompanies the oviduct in its course to the cloaca, where it opens close to the termination of that conduit.

1. **Corella parallelogramma** (O. F. Müller) Hancock.

(Plate XI, figs. 8 and 9; Pl. XXI, fig. 9; and figs. 30–34 in text.)

Ascidia parallelogramma O. F. Müller Zool. Dan. Prodr. [1776], p. 226, no. 2737; [Zool. Dan. Icon. II (1780), pl. xlix, ff. 1–3; Zool. Dan. Descr. II (1784), p. 25; and] Zool. Danica, II [1788], p. 11, pl. xlix, ff. 1–3; [Bruguière Hist. Nat. Vers, I (1789), p. 153, in Encycl. Méth; Bory de St. Vincent Vers, etc. I (1791), p. 135, pl. lxiv, ff. 8–10, in Tabl. Encycl. Méth; Gmelin Linnæi Syst. Nat. ed. 13, I, pt. 6 (1791), p. 3125; Bosc Hist. Nat. Vers, I (1802), p. 107; Turton Gen. Syst. Nat. IV (1802), p. 93; Fleming in Edinb. Encycl. II (1811), p. 544; Lamarck Hist. Nat. Anim. sans Vert. ed. 1, III (1816), p. 124, and ed. 2, III (1840), p. 529; Thompson in Ann. Nat. Hist. (1) V (1840), p. 94;] Forbes & Hanley Brit. Moll. I [1848], p. 34; [Rupert Jones in Cyclop. Anat. IV, pt. 40 (1850), p. 1201; Carus in Proc. Ashmol. Soc. II (1851), p. 266;] Thompson Nat. Hist. Ireland [IV (1856)], p. 360; Norman in Zoologist, [XV, (1857), p. 5708; Dickie in Rep. Brit. Assoc. for 1857 (1858), p. 111; Sars in Forh. Vid.-Selsk. Christ. 1858 (1859), p. 64; Schultze in Arch. f. mikr. Anat. XII, 2 (1862), pp. 178, 183; Alder in Ann. Nat. Hist. (3) XI (1863), p. 157, pl. vii, ff. 1, 2; in Nat. Hist. Trans. Northumb. Durh. I (1865), p. 11; and in Rep. Brit. Assoc. for 1866 (1867),

p. 208; Norman in Rep. Brit. Assoc. for 1868 (1869), p. 302].

Ascidia opalina Macgillivray Moll. Anim. Aberdeen [1843], p. 312.

Ascidia virginea Forbes & Hanley Brit. Moll. I [1848], p. 33, pl. C, f. 2; Alder & Hancock in Trans. Tyneside Nat. Field Club, I [1848], p. 200; [Cocks in Rep. R. Cornw. Polyt. Soc. 1849 (1850), p. 73; Rupert Jones in Cyclop. Anat. IV, pt. 40 (1850), p. 1201; Carus in Proc. Ashmol. Soc. II (1851), p. 266; Landsborough Treas. Deep (1847), p. 34, and Excurs. Arran (1852), p. 34;] Gosse Tenby (1856), p. 63; [Thompson Nat. Hist. Ireland, IV (1856), p. 360;] Norman in Zoologist, XV [1857], p. 5708; [Merrifield Nat. Hist. Brighton (1860), p. 81; Murray in Proc. R. Soc. Edinb. IV (1860), p. 271; Ansted & Latham Channel Isl. (1862), p. 219].

[*Phallusia virginea* Murray in Proc. R. Soc. Edinb. IV (1859), p. 149.]

Non *Ascidia virginea* O. F. Müller (1776).

[*Corella parallelogramma* Hancock in Ann. Nat. Hist. (4) VI (1870), p. 362.]

Body ovate or subquadrate, compressed, adhering by its base. *Apertures*, branchial very little prominent, scarcely tubular, atrial situated a little to one side on a longish tube surpassing the branchial in height; both with red ocelli. *Test* firm, hyaline, and perfectly transparent, showing the bright-coloured mantle through. *Mantle* thin, transparent, attached only at the tubes, more or less marked with crimson and opaque yellow. A circular belt of yellow is seen near the top of the branchial sac, and opaque yellow lines and spots (sometimes star-like) intermixed with crimson blotches, are dispersed over the sides. The dark intestine is seen proceeding from a fawn-coloured stomach on the left side, making a turn downwards at the base of the sac, and rising towards the anal aperture, accompanied by the white oviduct. On the right side there are a few strong radiating muscles near the margin of the mantle; they are absent on the left, and the meshes of the branchial sac are also seen more distinctly through. *Tentacular filaments*

long and slender. *Branchial sac* (fig. 30) with the secondary vessels arranged in spirals of five or six coils each; papillary membranes ample, with the free border considerably thickened, but scarcely produced into tentacular points. *Oral filaments* numerous, rather stout and pointed.

Height one to two inches; *breadth* about one third less.

Hab.—[Adhering to dead shells, Algæ, &c.,] at low water-mark and in deepish water.

On most parts of our coasts, but apparently rare in the south.

England.—Coast of Durham and Northumberland (*Alder; Hodge*). [Dogger Bank (*Alder*). Brighton, Sussex (*Merrifield*, 1860). Gwyllyn-vase, Swanpool, Pennance, etc., Falmouth, Cornwall (*Cocks*, 1849). Scilly Isles (*Carus*, 1850).] Isle of Man (*Forbes; Alder*).

Wales.—Tenby, Pembroke, at low water-mark (*Gosse*).

Scotland. — Aberdeen, abundant (*Macgillivray*). Firth of Clyde (*Norman; Carpenter*). Hebrides (*Forbes & McAndrew*). [Arran (*Landsborough*, 1847).] Shetland (*Forbes & McAndrew*); [10 miles east of Balta (*Norman*, 1868)].

Ireland.—Strangford Lough, Down, and Roundstone Bay, Connemara, Galway (*Thompson*).

First record.—[Thompson, 1840.]

This species is remarkable for its subquadrate form and the brilliancy of the pallial colouring; and it differs likewise from the other species of the genus in many points of detail.

After much investigation we have come to the conclusion that the *Ascidia virginea* of British authors is only a brightly-coloured variety of *Corella parallelogramma* of Müller, and that the true *A. virginea* of that author has yet to be discovered, at least on the British coast, if indeed it be at all known to modern

naturalists. In the figure of *A. virginea* given in the 'Zoologia Danica,' the intestine rises in a sigmoid curve half way up the side of the sac as is usual in the genus *Ascidia*; but in the present species, and indeed in all the three members of the genus *Corella*, the intestine, after running along the base of the sac, ascends in a direct line to the anal aperture, the stomach being placed on the left side. This is therefore a sinistral species, and its two congeners are the only other sinistral species which have occurred to us. The *Phallusia turcica* of Savigny is also a sinistral species, and has the same flexure of the intestine.

Corella parallelogramma is found on the Norwegian coast, but does not extend northwards beyond Lofoten, where it is rare and of small size (*Sars*).

2. **Corella larvæformis** Hancock.

(Plate XXII, fig. 8.)

Corella larvæformis Hancock in Ann. Nat. Hist. [(4) VI (1870), p. 363].

Body irregularly rounded or subquadrate, compressed, adhering by the base. *Apertures*, branchial terminal, only slightly prominent, atrial at the upper part of the neural margin, a little removed from the branchial, at the extremity of a tube which is considerably longer than the entire body, and projects diagonally upwards; ocelli red. *Test* firm, smooth, shining, thin above, rather thick below, perfectly crystalline, exhibiting not only the colours of the mantle, but likewise much of the internal structure. *Mantle* delicate, adhering to the test, of a yellowish or reddish colour, with a few scattered, small red spots, and so transparent that it does not in the least obscure the view of the contained visceral organs. *Branchial sac* with large, spiral coils, the largest about five times coiled, in 12 or 14 transverse rows; papillæ replaced by the thickened border of the papillary membrane.

Oral filaments minute, placed a little apart, not numerous. *Tentacular filaments* numerous, not crowded, long, delicate, and colourless.

Length from the base to the branchial aperture five-eighths of an inch, and to the atrial aperture an inch and a half.

Hab.—Shallow water.

Ireland.—Roundstone Bay, Connemara, Galway (*More*).

First record.—Hancock, 1870; *coll.* More, 1869.

We have seen only two individuals of this very characteristic species; they were both obtained in the same locality, and were taken in shallow water (from 6 to 12 fathoms) by Mr. A. G. More in 1869. They differ somewhat in colour; one having the mantle of a dull red, the other of a pale straw colour, and each having a few scattered spots of red. The body is much compressed and remarkably transparent, revealing almost the entire organization through the external coverings. But the most extraordinary feature is the enormous development of the atrial tube; it is considerably longer than the whole length of the body, and is proportionately wide; it is placed at the top of the ventral margin, only a short way removed from the branchial aperture, which is exactly terminal, and so little produced as to be scarcely tubular. From the peculiar development of the atrial tube, the form of this species has considerable resemblance to that of the usual tadpole larva, and suggests the adoption of the specific name.

The mantle is firmly adherent to the test, so that it cannot be detached without laceration; it is exceedingly delicate and but sparingly supplied with muscles. On the right-hand side there are a few scattered radiating fibres, darker than the rest of the mantle, near the upper and dorsal margin; there are likewise a few at the ventral margin; and a few still more delicate fibres are seen at the upper border of the left-

hand side; these and the sphincter belts of the tubes, together with a few short, longitudinal fibres near the orifices, complete the muscular apparatus of this organ.

The branchial sac is short and subquadrate, with the spirals comparatively few and large, arranged with some little degree of irregularity in 12 or 14 transverse rows; the larger spirals have about 5 or 6 coils, and they seem set in square areas, defined by the primary vessels and stout longitudinal secondary ones, in the same manner as in *C. parallelogramma*. The oral filaments are minute and correspond in number and position with the primary vessels; there are consequently not more than 12 or 14 of them. The branchial tubercle is apparently tubular, much restricted in length, and with a trilobed orifice at the free extremity, the upper lobe being the longest.

The alimentary canal is disposed much as it is in *C. parallelogramma*; the stomach is however a little more elongated; the œsophagus is rather long and narrow, and opens by a widish mouth near to the bottom of the branchial sac at the ventral margin; the intestine turns downwards at the dorsal margin, and, advancing along the bottom of the mantle, turns up the ventral margin attached to the branchial sac, and terminates at the base of the excurrent tube not far from the top of the sac; here it opens into the atrium by a wide orifice with the margin reflected and pectinated.

The ovary is a lobulated or tubular organ, spread over the right-hand side of the stomach, passing round the margin, and appearing at the left-hand side; the oviduct is wide, accompanies the intestine to its termination, and appears by the side of the anus. The male organ is spread over the posterior extremity of the left-hand side of the stomach and the intestinal loop; it is composed of minute, slightly-branched cæca; the vas deferens follows the oviduct to the atrium, and then, advancing a little beyond its termination, becomes adherent to the branchial sac, and opens some short distance in front of the anus.

The heart lies along the upper margin of the stomach; and the rest of the anatomy, so far as it could be determined, agrees with that of the type species.

C. larvæformis is distinguished at once from the congeneric species by the extraordinary elongation of the atrial tube, and from *C. parallelogramma* likewise by the comparative deficiency of colour, though much reliance cannot be placed on this character, as the specimens had been some time in spirit before they came into our possession. The fewness of the rows of branchial spirals, and the consequent comparative largeness of the spirals themselves, also distinguish this species.

3. **Corella ovata** Hancock.

(Plate XXII, figs. 10 and 11; and fig. 35 in text.)

Corella ovata Hancock in Ann. Nat. Hist. [(4) VI (1870), p. 363].

Body ovate, rather wide above, not much compressed, adhering by the side of the base, where there are a few root-like processes. *Apertures* very little produced, almost sessile; the branchial terminal, the atrial placed at a little distance down the ventral margin. *Test* soft, smooth, delicate, and perfectly transparent, revealing the colours and structure of the enclosed mantle and viscera. *Mantle* thin, transparent, of a buff flesh-colour, sometimes with a few obscure reddish markings; tubes very short, having the margins of the apertures of a pale flesh-colour; muscles few and delicate, of a reddish colour. *Branchial sac* with the spirals numerous and composed of only two or three coils; papillary membranes well developed and having the free margin not much thickened, and scarcely bearing at all the semblance of tentacular points. *Tentacular filaments* numerous, slender, not very long, set rather close together in a single line on a narrow

muscular band. *Oral filaments* numerous, well developed, with the points attenuated.

Length [sometimes] an inch and three quarters, but usually smaller.

Hab.—[Between tide-marks and] at low water.

Scotland. — Tobermorey, Mull, associated with *Ascidia rubicunda* and adhering to *Plocamium coccineum* (*Norman*).

Ireland.—Roundstone Bay, Connemara, Galway, in clusters attached to the test of *Ascidia Normani* (*More*).

First record.—Hancock, 1870; *coll.* Norman, 1866.

The test of this species (Pl. XXII, fig. 10) is so perfectly hyaline that when immersed in water it is difficult to observe its form; and usually the shrivelled yellowish mantle suspended within by the attachment of the tubes is so conspicuous that it is hard to believe that it is surrounded by the outer tunic. This is the case with specimens preserved in spirit; the brilliancy then, of this creature, may be increased in a living state, united as it is in clusters, and with the mantle fully expanded and imparting to the mass a delicate yellowish hue, intensified towards the base or visceral nucleus. When attached to Algæ, as it appears frequently to be, the base is much contracted, and then the body is decidedly ovate or pyriform with the upper end rounded and inflated. But the specimens which are adherent to a flat surface have the lower or basal portion a little more spread, and in these the form is more definitely ovate. The vascularity of the test seems limited to the lower portion.

The mantle (see Pl. XXII, fig. 10) lies free within the test, being attached to it only at the tubes and towards the base where the vascular trunks enter it. It is delicate and transparent, and appears to be highly contractile; the muscular fibres are, however, far from being robust; they are most developed on the right-hand side, and, like those in the other two

species, are disposed in a scattered radiating manner at the margins, but are confined to the upper portions; they partake of the colour of the mantle though they are a little darker. A few smaller radiating fibres are observed at the upper margin of the left-hand side.

The branchial sac (fig. 35) extends nearly to the bottom of the mantle, overlapping the right-hand side of the visceral mass; the spirals are remarkable for the fewness of their coils, there being usually two, rarely three, and they are stout and project boldly upwards; the longitudinal bars are delicate and cord-like, with the suspended membrane deep; the papillary

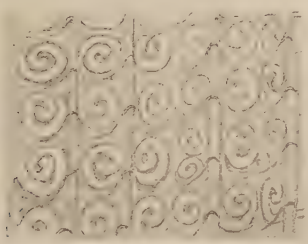


Fig. 35.—Part of branchial sac of *Corella ovata*. Much enlarged.

membranes are well developed, and have the free border only slightly thickened, and not projected into tentacular points or papillæ. There are about 36 oral filaments (Pl. XXII, fig. 11) which occasionally vary a little in length; they are wide at the base where the margins are sometimes a little undulated, and they rather suddenly attenuate upwards and are produced and pointed at the extremity. The branchial tubercle is a simple loop open in front above and pointed behind.

The disposition of the alimentary canal differs in no respect from that of the type form; the stomach is well marked and rounded, the œsophagus constricted and well produced; the intestine bends downwards in the usual manner and passes along the bottom of the sac to the ventral margin, which it ascends almost to

the top in a slightly curved line to the atrium, where it terminates in an anal orifice with a reflected and lobed margin.

The ovary is a branched tubular organ, for the most part confined to the right side of the intestinal loop, through which a few of the branches pass and appear at the left-hand side; a few of the terminal ramifications also overlap the dorsal border of the stomach and reach the other side of it. The male cæca, which are elongated, are for the greater part confined to the left-hand side of the looped portion of the intestine.

This delicate species is not likely to be confounded with either of its two congeners, from both of which it differs in many particulars, and notably by the general form and by the character of the branchial spirals, which in *C. ovata* are not by any means so many times coiled as they are in both the other species, and the coils themselves are much stouter. In *C. parallelogramma* and *C. larvæformis* the spirals are from 5 to 7 times coiled, while in *C. ovata* they are coiled only twice or thrice.

Family 2. Molgulidæ.

Animal generally free or only slightly attached. *Test* thin and membranous, often covered with sand or fragments of shells; usually not at all or but very slightly attached to the mantle, except at the two apertures. *Branchial aperture* 6-lobed, *atrial aperture* 4-lobed; ocelli inconspicuous or none. *Tentacular filaments* branched. *Branchial sac* generally with longitudinal folds, the meshes more or less perfectly convoluted, without papillæ.

Genus 4. **MOLGULA** Forbes, 1848.

[*Ascidia* (pars) O. F. Müller Zool. Dan. I (1788), p. 42.]
Molgula Forbes in Brit. Moll. I [1848], p. 36; Alder & Hancock in Trans. Tyneside Nat. Field Club, I [1848], p. 195; Woodward Man. Moll. [1856], p. 337; Gosse Man. Marine Zool. II [1856], p. 35; H. & A. Adams Gen. Recent Moll. II [1858], p. 590; [Alder in Ann. Nat. Hist. (3) XI (1863), p. 158].

Body ovate or globose, generally covered with glandular fibrils by which the animal accumulates a coating of sand or shells and in some species attaches itself to other bodies. *Test* usually thin, fibrillous, and nearly colourless. *Branchial aperture* 6-lobed; *atrial aperture* 4-lobed. *Tentacular filaments* more or less pinnate or branched. *Branchial sac* with longitudinal folds, the meshes irregularly convoluted. Stomach and intestine lateral. *Reproductive organs* on both sides, those of the right side situated above the lower intestinal loop.

The members of this genus are comparatively small and globular, with, usually, a coating of sand or of fragments of shells or stone. They have rarely any flattened surface of attachment like that of *Ascidia*, and consequently they are usually assumed to be free. This, however, may to some extent be questioned. The surface of the test is supplied with numerous hair-like processes or delicate branched fibrils. These adhere with considerable firmness to the more gritty matters mixed with the sand or fine mud in which these animals are undoubtedly to some extent buried. They thus become fixed in their position, and on removal bring along with them a coating of the attached particles. This would appear to be their usual habit. In some instances, however, they become adherent, through the agency of their external fibrils, to the surface of hard bodies, such as the exuviæ of mollusca, and cover the exposed portion of their test with the usual fragmentary matters.

The test of *Molgula* is thin, tough, and membranous, and is usually, if not always, covered with hair-like fibrils sometimes a little branched, by which it attaches a coating of sand or shelly particles. It is, with one or two exceptions, only very slightly adherent to the mantle, excepting at the respiratory tubes, where the attachment is firm. The mantle is very delicate and hyaline, and has a few muscular fibres radiating from the base of the respiratory tubes. These pass up the tubes, which are also supplied with circular fibres.

The mantle is richly supplied with a plexus of minute channels or vessels, and so is the intestinal tube, as well as the membranous branchial rod. The branchial suspenders are numerous and well developed, and, supplying the test, there are two vascular trunks which issue from the left side of the mantle or inner tunic near to the dorsal end of the heart. It may therefore be inferentially determined that the circulatory organs are of the same character, and are as complete, as they are in *Ascidia*. The heart is very distinct. It lies in the left-hand wall of the mantle, immediately below, and in contact with, the hard cylindrical body about which little has been determined.

The branchial sac is short and wide, extending, however, the full length of the pallial chamber, within which it is placed somewhat diagonally. There are usually six or seven wide, longitudinal folds on each side. In *M. complanata* there are six on the right side and seven on the left. These folds extend the entire length of the sac; but, as the ventral border is much shorter than the dorsal, those next the ventral line are not nearly so long as the dorsal ones, and they are all considerably arched, the concavity being turned forwards. The deep grooves, formed in the outer surface of the branchial sac by the inversion of the internal folds, are each turned into a series of pouches in consequence of the formation of septa at the points where the primary or transverse vessels cross them. The whole of the branchial surface between the transverse

or primary vessels is composed of a vast multitude of secondary vessels; those between the folds have an arched or more or less sinuous course in the longitudinal direction, but nevertheless have a tendency to curve towards the base of the folds, forming in fact the outer, irregular coils of large spirals. Within the folds these incipient coils go to form a series of small spirals usually arranged in pairs, composing the ultimate marginal recesses of the pouches. The pouches are limited by the large primary vessels, and are divided into two by the smaller primary vessels and then again each is subdivided; so that each pouch is, as it were, formed of four spirals arranged in pairs. It is uncertain whether this arrangement is constant, but it can usually be seen in well-preserved specimens. Other small vessels ramify in a transverse direction, but converge more or less regularly from the primary vessels towards the spiral centres; these are the radiating vessels.

Besides the large folds already described there are numerous, narrow, longitudinal, membranous bands which stretch the whole length of the organ; they are mostly confined to the folds, there being usually four on each side, while between the folds there are occasionally one or two. These minute membranous bands are the homologues of the longitudinal bars of *Ascidia*; and like them are connected with the vascular surface only at the points where they cross the large or primary vessels.

The above is the description of the branchial organ as it usually appears in *M. conchilega*. In *M. simplex* and *M. complanata* the spiral arrangement of the secondary vessels is much more distinct, and is well defined at the circumference of the coils. In these two forms the spirals therefore seem large and occupy nearly the whole surface, the centres terminating, apparently, in the pouches of the branchial folds. The minute membranous bands are in these two species confined entirely to the folds, there being none between

them; in each fold there are from four to six. The small transverse vessels distinctly radiate from the centre of the spirals.

In *M. inconspicua* the spiral disposition is reduced to the minimum. The secondary vessels have most generally a longitudinal direction, though they are curved sufficiently to show that they are portions of large compressed spiral coils, the centres of which are lost to view in the pouches of the folds; on each of these there are four or five longitudinal membranous bands obscuring their structure. The small, transverse, radiating vessels are well developed.

The oral lamina is a plain membrane, narrow above and widening as it reaches the mouth, beyond which, in *M. conchilega*, it passes downwards for some distance on the right side; but it usually terminates near the mouth. The branchial tubercle (Pl. XLVIII, fig. 1) occupies the usual place, immediately in front of the upper extremity of the oral lamina. It is not placed transversely as is usually the case; but in this genus is generally oblique with the involutions inclined downwards.

The endostyle is well developed, and forms a rather wide groove from one end of the branchial sac to the other, and is much arched, following the curvature of the folds. Both the anterior and posterior cords are well displayed.

The tentacular filaments at the base of the inhalant tube are always more or less pinnate or branched. In *M. conchilega* there are eight or nine such filaments with smaller intermediate ones. They are simply pinnate. *M. simplex* has about eleven, with a few minute ones interspersed; they are imperfectly tri-pinnate, and have an irregular bushy appearance. In *M. inconspicua* they are less bushy, and the branches are more regularly disposed; and in *M. complanata* they are simply pinnate, the pinnæ being few in number.

The digestive organs lie on the right side of the branchial sac, adherent to the pallial wall, from which

they bulge, rolled in a fold of the lining membrane. The oral orifice is large and circular, and opens into the base of the branchial sac close to the ventral margin. The œsophagus is a short, ill-defined tube, which gradually enlarges backwards as it merges into the stomach; this is a mere irregular enlargement of the alimentary tube, and is somewhat elongated; it is of no great size, and as it passes downwards it bends backwards and graduates into the intestine, which is a large, pretty-equal tube, that runs across nearly as far as the endostyle at the opposite or dorsal margin of the body; it then ascends, and, doubling upon itself, forms a transverse loop; after this it again ascends and reaches the atrium just above the point where the œsophagus penetrates the respiratory organ. There it terminates in a wide anal orifice with a slightly-reflected rim which is broken at the side next the branchial sac.

The liver, in this genus, is a well-developed organ. It is usually of a dark green colour, and overlies the stomach, concealing entirely its inner or right side, and very much obscuring its general form. It is an irregularly-lobulated mass which appears to be made up of wide laminæ closely pressed together and more or less confused and involved. This is the appearance of the hepatic organ in *M. conchilega*; but in *M. complanata* the laminæ and lobes are very distinct, and the mass has very much the appearance of a folliculated and lobed sac.

The digestive organs do not vary much in the different species. In *M. simplex* the intestine is much elongated, and passes from one margin of the body to the other, the looped portion being turned upwards and forwards so as to pass above the reproductive organs, and the margin of the anal orifice being denticulated and reflected. There are consequently two distinct loops in this species, an upper and a lower loop. In *M. inconspicua* the intestine is still more extensively developed, the upper loop being wide, and,

after advancing to near the top of the sac, it turns downwards, and in a great measure passes in front of the generative mass.

The reproductive organs are in two masses, which are placed, one at each side of the body, adhering to the mantle and bulging out the lining membrane. They are, in *M. conchilega*, of an irregular oval form and somewhat arched, each being composed of both male and female elements. That on the right side lies in contact with and directly above the rectal portion of the intestine, the loop being below and behind it. The ovigerous portion of the organ forms the upper border of the mass, and is an elongated, lobed sac, with the anterior or ventral end produced into a short, constricted duct, which opens into the atrium at the right side of, and a little way above, the anus. The testis is composed of a vast number of branched vesicles or cæcal tubes, crowded together and sometimes assuming a dendritic appearance; the mass thus constituted is elongated and lobulated, and forms the lower margin of the ovary, in close contact with the intestine. There are four or five long, nipple-like sperm-outlets or ducts, rising up in a line, at a little distance from each other, on the surface of the testis, towards its lower border. These convey the male secretion into the atrial space by the side of the branchial sac.

The reproductive mass on the left side is similar to that on the right; it is, however, less regular in form, and the male and female portions have in great measure changed places; for, on this side, the male secreting vesicles occupy for the most part the upper border of the organ, the female the lower. The whole mass lies immediately above the curious, cylindrical organ in connection with the heart. The oviduct opens into the left-hand side of the atrium a little above the anus. The sperm-outlets are as in the right-hand mass.

In *M. simplex* and *M. inconspicua* these organs are

narrower and more regularly elliptical than they are in *M. conchilega*, and the oviducts are shorter. In both species, too, the mass on the right side is much arched, and lies between the lower or rectal portion of the intestine and the upper loop, or within what may be termed the lower loop. A more interesting modification is found in *M. complanata*. In this curious depressed species the intestine forms a simple loop as in *M. conchilega*, and the reproductive organs, which are placed as usual, are of a narrow ovate form, with the oviduct about one third the length of the intestine, projecting from the attenuated extremity, which is directed backwards, that is from the cloaca and towards the endostyle. The ova must therefore be shed into the dorsal portion of the atrium and not into the cloaca, as they usually are in all the other species. The organ on the right side is placed a little above the extremity of the intestinal loop; that on the left is situated well backwards and considerably above the cylindrical organ connected with the heart.

1. **Molgula conchilega** (O. F. Müller).

(Pl. XXIII; Pl. XLVIII, fig. 1; and fig. 36 in text.)

Ascidia conchilega O. F. Müller Zool. Dan. Prodr. [1776], p. 225, no. 2727; [Zool. Dan. Icon. I (1777), pl. xxxiv, ff. 4–6; Zool. Dan. Descr. I (1779), p. 84; and] Zool. Danica, I [1788], p. 42, pl. xxxiv, ff. 4–6; Bruguière Hist. Nat. Vers, [I (1789), p. 147,] in Encycl. Méth.; [Bory de St. Vincent Vers, etc. I (1791), p. 135, pl. lxii, ff. 11–13, in Tabl. Encycl. Méth.; Gmelin Linnæi Syst. Nat. ed. 13, I, pt. 6 (1791), p. 3124; Bosc Hist. Nat. Vers, I (1802), p. 104; Turton Gen. Syst. Nat. IV (1802), p. 94; Fleming in Edinb. Encycl. II (1811), p. 544; Jameson in Mem. Wernerian Soc. I (1811), p. 557; Pennant Brit. Zool. ed. 5, IV (1812), p. 100; Lamarck Hist. Nat. Anim. sans Vert. ed. 1, III (1816), p. 123; Stewart Elem. Nat. Hist. I (1817), p. 392; Stark Elem. Nat. Hist. II (1828), p. 117; Lamarck Hist. Nat. Anim.

sans Vert. ed. 2, III (1840), p. 528; Thompson in Ann. Nat. Hist. (1) XIII (1844), p. 424;] Forbes & Hanley Brit. Moll. I [1848], p. 35; [Cocks in Rep. R. Cornw. Polyt. Soc. 1849 (1850), p. 73; Johnston Introd. Conch. (1850), p. 177; Rupert Jones in Cyclop. Anat. IV, pt. 40 (1850), pp. 1193, 1201; Thompson Nat. Hist. Ireland, IV (1856), p. 359; Bronn Thier-Reichs, III, 1 (1861), p. 109].*

Body transversely oval, rather compressed, unattached, completely covered with fragments of shells so as to conceal every part excepting the little-conspicuous apertures when expanded. *Apertures* not far apart, slightly tubular, the branchial largest. *Test* (when freed from its shelly coat) thin, white, transparent, and clothed with irregularly-formed fibrils or expansions of the outer layer of the test, which rise from a broad base and generally expand at the top. *Mantle* white with a bluish tinge. *Tentacular filaments* very irregular in size, stout, sub-bipinnate. *Branchial sac* with seven folds on each side, the meshes very irregularly convoluted. *Oral lamina* smooth.

Largest diameter about an inch and a quarter.

Hab.—?

England.—Coast of Northumberland (*Alder & Hancock*). Polperro [*? Loughrin*], and Falmouth, Cornwall (*Cocks*).

Scotland.—[Leith shore (*Jameson*).] Frith of Clyde (*Goodsir*).

Ireland.—Coasts of Antrim and Down (*Thompson*) [1844]. Connemara, Galway [*? More*].

First record.—[Jameson, 1811.]

The description of this species is taken from specimens kindly presented to us by the late Professor Goodsir, which we have little hesitation in referring to

* It will be seen that only four of these references are given by the authors, namely Müller (2), Bruguière, and Forbes & Hanley. "*Pandocia conchilega*, Flem. Brit. Anim. 468," also appears in the transcript of their MS., but as an addition, in a different handwriting from the rest. Fleming's *Pandocia conchilega* appears to be Savigny's *Cynthia mytiligera*, and if so, as this belongs to his tribe *Cynthiæ Pandociæ*, it is not a *Molgula*. This synonym, with other references dependent upon it, is therefore omitted.

the *Ascidia conchilega* of Müller. We are glad to find that the late Professor Sars was also of opinion that *A. conchilega* is a *Molgula*. Of two specimens sent to us by Professor Lovèn under this name, both covered with shelly fragments, and not to be distinguished from each other in external appearance, we found on dissection that one was a *Molgula* of this species and the other a true *Ascidia*. A *Cynthia*, too, *C. glacialis*, is in like manner invested with fragments of shells, and scarcely distinguishable from these externally, so little can external characters be relied upon in this family, even in generic points of view, when the

Fig. 36.—Part of branchial sac of *Molgula conchilega*. Much enlarged.

apertures are concealed. All three were unattached. The specimens received from the late Professor Goodsir were covered with largish fragments of shell; those obtained on the Northumberland coast are more commonly clothed with mere sand, sometimes having minute shelly matter intermingled. The size of the particles of this extraneous coating depends on the accidental condition of the kind of sea-bottom on which the specimens occur, as might be expected, for there is not anything to show that the animal has the power of selecting these fragmentary matters, but on the contrary it appears that it attaches indiscriminately those amidst which it happens to be placed.

The mantle (Pl. XXIII, figs. 1–3) is delicate and transparent, with the radiating muscles towards the base of the tubes well developed; the walls of the tubes are rather stout, and are occasionally of a yellowish flesh-colour.

The structure of the branchial sac (Pl. XXIII, figs. 4–6, and fig. 36 in text) is very beautiful; the external surface exhibits with great distinctness the rows of large quadrate openings leading into the pouches of the internal folds; and the inner surface has a rich, delicate, lace-like appearance. The seven longitudinal folds are well arched and are prettily marked or reticulated, chiefly by the membranous bands or rods which stretch along them from end to end, and the primary transverse vessels which cross them in a somewhat radiating manner from the ventral to the dorsal margin. There are four or five of these bands, or rods, on each fold; they are rather wide and have the free border thickened or cord-like. The spiral arrangement of the secondary vessels is very complicated and difficult to trace on account of the multiplicity of the parts; on the surface between the folds the vessels take an undulatory course more or less in a longitudinal direction, with here and there a tendency to a spiral disposition; but within the pouches towards the margins of the folds the spirals are much more perfectly defined, though it is difficult even here to trace them with precision; but it is distinctly seen that the centres of the spirals are arranged in pairs at the bottom of the pouches or within the margins of the folds. The oral lamina is plain, much widened near the mouth, and narrow upwards. There are 8 or 9 large tentacular filaments with smaller ones between them, in all 18 or 20; they are sometimes decidedly bipinnate, but most frequently only imperfectly so, being to a great extent merely pinnate.

The alimentary canal (Pl. XXIII, figs. 1–3) forms a single open loop which reaches nearly to the dorsal margin. The liver (Pl. XXIII), which is of a green

colour, appears to be more highly organized than it is in most of the species; it is composed of laminated lobes, which on the external surface appear as two masses; one, the smaller, is at the ventral margin of the œsophagus, between it and the intestine; the other, considerably larger, lies against the dorsal margin of the stomach; these two masses are united and overlie the right or inner side of that organ, entirely concealing it when viewed from that aspect. The anus has a simple, smooth, reflected margin.

The cylindrical organ in connection with the heart is long and well curved; and the reproductive organs are somewhat irregular in form.

2. **Molgula complanata** Alder and Hancock.

(Plate XXIV, figs. 1–6; and fig. 37 in text.)

Molgula complanata Alder & Hancock in Ann. Nat. Hist. [(4) VI (1870), p. 366].

Body much depressed, rather longer than broad, adhering diagonally by nearly the whole length of the left side, covered with sand and small fragments of shell. *Apertures* at a little distance apart; the branchial towards the margin, the anal about the centre of the disc. *Test* rather thin, covered with long simple fibrils to which the sand is attached; under surface very thin and smooth with only a few grains of sand. *Mantle* transparent, slightly attached to the test, and with strong radiating muscles around the apertures. *Tentacular filaments* simply pinnate. *Branchial sac* with six folds on the right side and seven on the left; the [secondary vessels distinct, and the] meshes a good deal convoluted. *Intestinal canal* forming a single long loop. Liver pale green, folded or laminated. *Reproductive organs* composing an oblong-ovate mass on each side; the oviducts turned to the posterior margin.

Length one third of an inch.

Hab.—[Deep water?]

Channel Islands.—Guernsey, adhering to the inside of a dead shell of *Patella vulgata*; dredged (*Jeffreys & Norman*).

First record.—Alder & Hancock, 1863; *coll.* Jeffreys & Norman.

We have seen only one specimen of this well-characterized species; it is attached diagonally by the greater portion of the left side, and is so much depressed that it is quite discoidal in form, but a little transversely elongated.

The mantle is delicate and transparent, and is minutely papillose on the outer surface, the papillæ being scattered and of a clavate form; it adheres slightly to the test, but can be removed with care.

Fig. 37.—Part of branchial sac of *Molgula complanata*. Much enlarged.

The branchial sac (Pl. XXIV, fig. 4, and fig. 37 in text) is co-extensive with the body, and is consequently pretty-regularly oval. The orifices of the branchial pouches on the outer surface are small and elliptic, but distinctly defined. The folds, of which there are six on the right side and seven on the left, are regularly and strongly arched, with the concavity towards the ventral margin, the arch increasing in depth as the folds recede from the ventral margin. The secondary vessels form large, distinct, but somewhat irregular spirals, which seem to centre in the folds, there being only one or two to each pouch; the meshes are wide, comparatively few, short and simple, but sometimes enlarged into irregular spaces. The radiating vessels

are more regular and less numerous than usual. The folds are rather narrow and they have on each side three or four membranous bars. The endostyle follows the curvature of the folds and is very long, reaching almost to the oral orifice. The oral lamina is not very wide, but gradually tapers from the mouth upwards. The tentacular filaments are pretty-regularly uniform in size and are simply pinnate.

The alimentary canal (Pl. XXIV, figs. 1 and 3) forms a simple, open loop, which does not extend much more than half the width of the body. The stomach appears to be quite small, and is not well defined; it is entirely concealed by the hepatic lobes, of which, on the right, or outer, or exposed side there are four, on the left, or inner, there is but one large ovate mass. The component laminæ, of a pale green colour, are short, thick, and strongly defined. The anal orifice (Pl. XXIV, fig. 3) has a smooth reflected border.

The reproductive organs (Pl. XXIV, figs. 1–3) are elongated, ovate, slightly arched bodies, with the ducts, which issue from the narrow end, turned towards the dorsal region, or in the opposite direction to that which is usual. The right-hand organ is placed a little above the extremity of the intestinal loop; that on the left side occupies relatively nearly the same position, and is removed some distance from the cylindrical, cardiac body which is about midway between it and the dorsal margin, towards the lower end of the sac. This peculiar organ in connection with the heart is rather small; but is considerably arched and has the ends irregularly rounded.

Numerous ova, in every stage of development, up to the perfect tadpole larva (Pl. XXIV, fig. 6) occupied the water-spaces between the branchial sac and mantle. The larva is of a pale yellow colour; the body much elongated, with the anterior end a little produced, and the extremity of the tail supplied with a fin-like membrane.

M. complanata is readily distinguished from its congeners. The depressed form and large surface of attachment are characters very unusual in this genus. Another peculiarity is the reversed position of the oviducts.

3. **Molgula oculata** Forbes.

(Plate XXIV, figs. 7–10.)

Molgula oculata Forbes in Brit. Moll. I [1848], p. 36, pl. D, f. 6; [Cocks in Rep. R. Cornw. Polyt. Soc. 1849 (1850), p. 73; Rupert Jones in Cyclop. Anat. IV, pt. 40 (1850), p. 1193; Forbes in Rep. Brit. Assoc. for 1850 (1851), p. 243; Woodward Man. Moll. (1856), p. 337; Bronn Thier-Reichs, III, 1 (1861), p. 109; Ansted & Latham Channel Isl. (1861), p. 219].

[*Molgula ocelata* (male pro *oculata*) Cocks in Rep. R. Cornw. Polyt. Soc. 1851 (1852), p. 17.]

Body globose, adhering slightly at the base, or sometimes free, closely encrusted with fragments of shells and pebbles, excepting a smooth, depressed, sharply-defined, reniform space above, which is soft, translucent, and blotched concentrically with bluish green and orange or yellow. *Apertures* short and wide, situated within the smooth space. *Test* (when stripped of its coat of extraneous matter) thin, soft, transparent, and colourless; set with irregular, longish, glandular (hair-like) fibres, to which the shells and pebbles adhere. *Mantle* very thin and transparent, with difficulty separated from the test. *Tentacular filaments* branched, bipinnate. *Branchial sac* with seven rather narrow folds on each side, the meshes (secondary vessels) irregularly convoluted.

Diameter two to two and a half inches.

Hab.—[Laminarian zone, adhering to shells.]

England. — Torbay, Devon (*Alder*). Plymouth, Cornwall, adhering to a scallop in 25 fathoms; dredged (*Forbes & McAndrew*). [Helford River, Falmouth, Cornwall; in trawl refuse (*Cocks.*)]

Channel Islands—Guernsey (*Norman*).

First record.—Forbes, 1848; *coll.* Forbes and McAndrew [1846].

Professor Edward Forbes compares the apertures of this very singular *Molgula* to eyes set in a spectacle-frame. Owing to the softness of the test, the animal collapses much in dying, the centre falling in, while the sides are kept out by the stiffening of shelly matter, so that the body assumes something of a saucer-shape. The external fibres are numerous, stout, twisted and angulated, with irregular pointed processes; they are frequently enlarged at the extremity.

The mantle (Pl. XXIV, figs. 7 and 8) is exceedingly delicate and so firmly adherent to the test that it cannot be removed without laceration; it is perfectly hyaline.

The branchial sac (Pl. XXIV, fig. 10) has seven folds on each side, the folds have four membranous rods at the sides, and there is usually one a little distance from the base. The spirals are large and irregular, and are centred in the folds, the radiating vessels being numerous and stout, giving to the organ a beautifully-trellised appearance. The branchial tubercle is oval, with the convolutions, which are well developed, turned downwards and backwards. There are 14 or 15 bipinnate tentacular filaments, somewhat irregular in size.

4. **Molgula valvata** *sp. nov.*

(Pl. XXV, fig. 1; and figs. 38 and 39 in text.)

Body transversely ovate, slightly compressed, unattached, thinly covered with minute particles of sand and mud. *Apertures* a little apart, wide and moderately produced, placed in a narrow depression, with the margins expanded into valvular folds. *Test* rather delicate, soft, and colourless, covered with numerous, very delicate, angulated fibrils. *Mantle*

thin and transparent, free or attached only at the tubes. *Alimentary canal* largely developed, forming two loops, both of which extend the entire width of the body; the liver of a pale green colour. *Reproductive organ* of the right side fusiform, lying upon the rectum within the lower loop.

Longest diameter three-eighths of an inch.

Hab.—?

Scotland.—Hebrides.

First record.—Alder & Hancock.

We have seen only a single individual of this well-marked species (figs. 38 and 39), and unfortunately the internal parts were much injured, so that many of the

Fig. 38.

Fig. 39.

Figs. 38 and 39.—Test of *Molgula valvata*. 38, side view; 39, as seen from above. Three and a half times natural size.

characters could not be determined. The external features, however, are sufficiently distinct, though they resemble to some extent those of *M. oculata*, to which the present species is undoubtedly closely allied. It is distinguished, nevertheless, from that species by the membranous valvular expansions within which the tubes are placed. In *M. oculata* the margins of the tubular area are not produced, while in *M. valvata* they form two distinct membranous folds of considerable width which extend from near the ventral margin to about two-thirds across the body; these folds are approximated between the tubes and are separated a little in their immediate vicinity, so that here as well as in *M. oculata* the perforated tubes simulate a pair of

eyes looking through spectacles. The external fibrils, too, are very different; in *M. valvata* they are extremely delicate and hair-like, and are much contorted and confused; but in *M. oculata* they are stout, and, though twisted and angulated, can be easily traced. And again in the latter the mantle is strongly adherent to the test, while in *M. valvata* (Pl. XXV, fig. 1) it is, as usual, entirely free except at the tubes.

5. **Molgula simplex** Alder & Hancock.

(Pl. XXV, figs. 2 and 3; and figs. 40 and 41 in text.)

Molgula simplex Alder & Hancock in Ann. Nat. Hist. [(4) VI (1870), p. 365].

Body globular, sub-pellucid, nearly smooth, free, or very slightly attached. *Apertures* nearly terminal, not far apart, slightly tubular and retractile. *Test* rather soft but tough, generally rather thinly clothed with linear fibrils, which are rarely forked, and seldom have any sand or shell adhering to them. *Tentacular filaments* branched, irregularly tripinnate, about eleven in number with minute ones interspersed. *Branchial sac* with six folds on each side, the meshes distinctly but irregularly convoluted. *Oral lamina* smooth, broad below. *Intestine* forming two loops confined to the lower half of the sac. *Reproductive organs* forming a slightly arched mass on each side, with the margins divided into narrow irregular lobes, that of the right side within the lower intestinal loop.

Diameter one-half to three-quarters of an inch.

Hab.—?

England.—Torbay, Devon, and Plymouth, Cornwall (*Alder*).

Scotland.—Oban, Argyll (*Alder*).

Ireland.—Strangford Lough, Antrim, and Ballywalter, Down (*Thompson*).

First record.—Alder & Hancock, 1870.

The mantle of this species (Pl. XXV, figs. 2 and 3) is very delicate and transparent; but the radiating muscles at the base of the tubes are well developed. The branchial folds (fig. 40) are rather narrow and

Fig. 40.—Part of branchial sac of *Molgula simplex*. Much enlarged.

have on each side two or three membranous bars or rods and one immediately at the base. The spirals are large and distinct, though without perfect regularity; there appears to be but one to each branchial pouch; the meshes are wide and irregular in size and form;

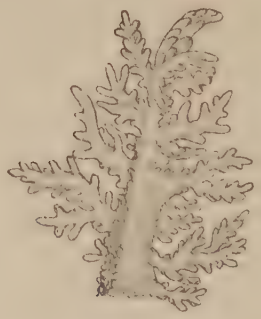


Fig. 41.—A tentacle of *Molgula simplex*. Highly magnified.

the radiating vessels are distinct and pretty-regularly arranged. The branches of the tentacular filaments (fig. 41) are rather irregularly disposed so as to give them a bushy appearance. The extremity of the lower

loop of the intestine reaches to the dorsal margin; but the upper loop is comparatively short and extends only about half way across the body. The liver is distinctly lobed and laminated; and the anal orifice is margined by a rim of nine or ten reflected processes.

The reproductive organs are considerably elongated and pretty-regularly elliptical, and the margins, when seen from the exterior, present a double series of ovarian lobules; the oviducts are short, constricted, and directed towards the atrium. The male cæca, which are extremely minute, form on the opposite or inner side of the masses two or three large irregularly-rounded nodules.

Molgula simplex has much the external appearance of *Eugyra arenosa*, agreeing with it in size and form, but differing in the absence of the sandy covering. An examination of the branchia, however, will at once show the distinctness of the two species. *M. simplex* has also considerable resemblance to the *Ascidia ampulloides* of Van Beneden, which is undoubtedly a *Molgula*. That species appears to be larger than ours and to have more extended tubes; the test, too, is described as being solid and thick, which is not the case here.

6. **Molgula siphonata** Alder.

(Pl. XXV, figs. 4–6; Pl. XXVI, figs. 1–4; Pl. XL, figs. 1 and 2; and figs. 42 and 43 in text.)

Molgula siphonata Alder in Trans. Tyneside Nat. Field Club, I (1850), p. 362.

Molgula siphonalis Sars in Forh. Vid.-Selsk. Christ. 1858 (1859), p. 65.

Body roundish or oval, inflated, closely covered with a coating of fine sand; attached by a small base. *Apertures* long, non-retractile tubes, nearly terminal, a short distance apart, covered with sand like the body; branchial tube about a quarter of an inch long and as wide; atrial longer and narrower. *Test* soft,

rather stout, yellowish brown or nearly colourless, set with short, stout fibrils to which the sand adheres. *Mantle* transparent, of a purple or lilac colour, showing the viscera through, especially the ovaries, which form white crescent-shaped double lines on each side. *Tentacular filaments* bipinnate, alternately large and small. *Branchial sac* with six deep folds on each side, the meshes spirally but irregularly convoluted.

Fig. 42.—Test of *Molgula siphonata*. One and a half natural size.

Length, including the tubes, [an inch and a quarter to] an inch and a half; *breadth* nearly the same but variable.

Hab.—Coralline zone.

England.—Cullercoats and Newbiggin, Northumb., where it is occasionally brought in on the fishermen's lines (*Alder & Hancock*). Torbay, Devon (*Alder*).

First record.—Alder, 1850.

Molgula siphonata is generally found attached to the slender stems of flexible zoophytes from the coralline zone, and is not infrequently partially concealed by

the accumulation of the branches; while the yellowish brown colour of the test, harmonising well with that of the zoophyte, renders the creature rather inconspicuous.

The test (Pl. XXVI, fig. 1, and fig. 42 in text), though not by any means thick, is comparatively stout for a *Molgula*, and is tough and coriaceous; the fibrils (Pl. XL, fig. 2) are short and strong.

The mantle (Pl. XXV, figs. 4 and 5, and Pl. XXVI, fig. 2) is thin and transparent, and on the left side there are a few scattered, transverse fibres towards the dorsal margin; the usual radiating muscles at the base of the tubes are not apparent, but whether from deficiency or from obscuration is uncertain.

The external surface of the branchial sac (Pl. XXV, fig. 6) exhibits very distinctly the openings of the six rows of pouches; the orifices are long and narrow, and are divided by the primary vessels. The gill-folds, of which there are six on each side, are supplied on both sides with three membranous rods; and the secondary vessels are arranged much in the same manner as they are in *M. conchilega*, that is, between the folds they show little disposition to form spirals, and run chiefly in a longitudinal direction, though considerably curved and undulated; they assume, however, a spiral direction within the margin of the folds, where the spirals are arranged in pairs. The radiating vessels are numerous and conspicuous, and rise boldly in relief from the inner surface of the sac (Pl. XXVI, fig. 4). The oral lamina is smooth, wide at the mouth, and narrowed upwards. There are sixteen alternately large and small, bipinnate tentacular filaments (Pl. XL, fig. 1); they are a little apart, stout and large.

The alimentary canal forms two loops, the lower of which is wide, the upper narrow and not much produced; the whole being placed towards the bottom and ventral margin of the sac. The liver is composed of fine laminæ, which are regularly arranged on each side of a median line; the lobe of the right side

is not displayed externally; the anal margin is fringed with six or seven large, obtuse, reflected processes.

The reproductive organs (fig. 43) are large, elongated, crescentic bodies, each of which is composed externally of an irregular double row of white or yellowish ovigerous lobes; and on the inner surface there are three or four large, irregularly-rounded, white bodies composing the male organ; the oviducts are short and wide, and issue from the ventral extremity of the organ in the direction of the atrium; the vas deferens is short and much constricted, adheres to the inner surface of the ovary, and opens near the origin of the oviduct. In one of the two specimens examined the right-hand

Fig. 43.—Reproductive organs of *Molgula siphonata*. Magnified. *v.* Ovary. *od.* Oviduct. *ts.* Testis. *v. d.* Vas deferens.

organ had both the ovarian and spermatic ducts with two nipple-like outlets, one probably being ovarian, the other spermatic; it may be that this is the normal condition of the right-hand genital mass.

The cardiac cylinder is wide, decidedly arched, and well rounded at the extremities.

7. **Molgula socialis** Alder.

(Pl. XXVII, figs. 1 and 2; Pl. XXVIII, figs. 1 and 2; Pl. XLVIII, fig. 2; and fig. 44 in text.)

Molgula socialis Alder in Ann. Nat. Hist. (3) XI [1863], p. 159.

Body ovate, covered with fine sand, adhering by a

small base. *Apertures* terminal, approximate, rather small, tubular. *Test* greenish, thin, soft, covered with longish, unbranched, rather rugged, glandular fibrils. *Mantle* greenish, soft, attached to the test only at the tubes. *Tentacular filaments* large, much branched, tripinnate. *Branchial sac* with six folds on each side; the meshes very short, irregular, and imperfectly convoluted. *Oral lamina* very narrow. *Intestine* forming two loops. *Reproductive organs* narrow, elongated, slightly arched. Densely gregarious.

Height about half an inch.

Hab.—[Coralline zone (?), attached to shells.]

England.—The "Diamond" trawling ground near Hastings, Sussex [attached to *Pecten maximus*] (*Bowerbank*).

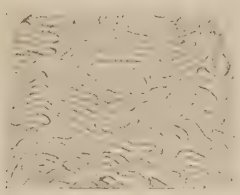


Fig. 44.—Part of branchial sac of *Molgula socialis*. Much enlarged.

First record.—Alder, 1863; *coll.* Bowerbank.

Unlike the other species of the genus, which are generally solitary, this *Molgula* is associated in dense masses, firmly adhering to each other by the instrumentality of the fibrils, and so closely crowded are they as frequently to press the sides, giving rise to a square, pentagonal, or hexagonal form. The test is tough and densely covered with fine sand.

The mantle (Pl. XXVII, figs. 1 and 2), though transparent, is thicker than usual and is pretty uniformly of a pale green colour; the radiating muscles at the base of the tubes are delicate and rather inconspicuous.

The external surface of the branchial sac (Pl. XXVIII,

figs. 1 and 2, and fig. 44 in text) displays, in distinct much-curved lines, the rows of the pouch-orifices, which are of a squarish form; the folds are rather wide and deeply arched, the lower extremities being turned well forward towards the oral orifice; the ventral margin is much contracted, consequently the anterior folds are short, as well as the oral lamina, which is extremely narrow. Between the folds the secondary vessels are very irregular and are only approximately convoluted, the stomata being short and variously contorted. Within the folds there are obscure indications of spirals, arranged as usual in pairs; the folds bear three or four wide, membranous rods on each side. The branchial tubercle (Pl. XLVIII, fig. 2) is well developed. There are twelve or fourteen very large, tripinnate, tentacular filaments, which are pretty equal in size, and form a bushy fringe at the base of the tube.

The intestinal loops, of which there are two, are placed diagonally upwards and forwards, the upper loop not quite reaching across the mantle; the anal orifice has a narrow, smooth, reflected rim.

The genital organs (Pl. XXVIII, figs. 1 and 2) are rather long and narrow, and somewhat curved; the right-hand ovary fills up the space within the lower loop, and the left-hand one is placed a little above the cardiac cylinder; they are each composed of an indistinct double longitudinal series of irregular ovarian lobules. The male organ appears to be made up of two or three irregularly-rounded bodies placed towards the front of the mass. The ducts of the two elements are placed one over the other, and so closely united as to appear as a single delicate constricted tube; they terminate a little in front of the organ in two nipple-like orifices.

The cardiac cylinder is situated a little below the genital organ, and is short, almost straight, with the extremities obtuse.

8. **Molgula inconspicua** Alder & Hancock.

(Plate XXVII, figs. 3–5; and fig. 45 in text.)

Molgula inconspicua Alder & Hancock in Ann. Nat. Hist. [(4) VI (1870), p. 366].

Body globular, rather firm, covered with sand and [fragments of] shell; unattached. *Apertures* approximate, tubular. *Test* tough, clothed with irregular linear fibrils. *Mantle* slightly attached to the test, thick and fleshy towards the upper part, thinner below, the intestine showing through. *Tentacular filaments* bipinnate. *Branchial sac* with six folds on each side, the meshes very slightly convoluted or almost linear. *Oral lamina* smooth. *Intestinal canal* large, reaching near to the top of the sac, twice looped. *Liver* dark green. *Reproductive organs* forming a long, curved, elliptical mass on each side, with the margins divided into irregular lobules, that on the right side within the lower intestinal loop.

Diameter one-quarter to one-third of an inch.

Hab.—?

Channel Islands.—Guernsey; dredged (*Jeffreys & Norman*).

First record.—Alder & Hancock, 1870; *coll.* Jeffreys & Norman [1865].

We have seen only one specimen of this species; it is globular, or perhaps a little ovate with the lower extremity wide and well rounded. The test is tough and is readily divisible into two layers.

The mantle (Pl. XXVII, figs. 3 and 4) is of a pale, soiled greenish colour (the specimen was preserved in spirit), and is much stouter than usual, particularly at the upper part, where, in the region of the tubes, it is quite thick and fleshy; it is attached to the test though not very firmly; the radiating muscles are not perceptible externally, but are seen on the inside to be

stout and widely separated; the tubes are wide, well produced, and terminal; they are placed rather near together, the atrial being scarcely at all lateral; and their walls are rather thick like the upper portion of the mantle.

The branchial sac (fig. 45) is remarkable for the simple arrangement of the secondary vessels, which are much less curved and sinuous than usual, the approximation to the spiral type being very obscure

Fig. 45.—Part of branchial sac of *Molgula inconspicua*. Much enlarged.

but nevertheless quite determinable; the primary vessels are pretty distinct, and the radiating ones more simple and parallel than in most of the species, and there are four or five membranous rods on each side of the folds, which are strongly arched; the endostyle is equally deeply curved and is long; the oral lamina is short, the space between the mouth and branchial tubercle being rather contracted; it is narrow, smooth, and a little widened as it approaches the oral orifice. The tentacular filaments are bipin-

nate, and the branches are somewhat regularly disposed.

The alimentary canal (Pl. XXVII, fig. 5) is voluminous and entirely fills up the lower portion of the sac; there are two large loops, the upper of which, after passing about two-thirds up, bends downwards near the centre of the mouth. The liver (Pl. XXVII, fig. 5) is of a dark obscure green, and is seen externally as two masses by the sides of the stomach, that on the ventral side being comparatively small; it appears more highly organized than usual, and is composed of a few large, transverse laminæ or fold-like lobes. The anal margin is narrow, smooth, and reflected.

The reproductive organs (Pl. XXVII, fig. 5) are rather large, considerably elongated, and well arched, with the margins irregularly lobulated on the external surface; on the inner surface they are seen to be composed of two elements; the upper longitudinal half of the right-hand organ, and the lower of the left-hand one, are paler than the rest, or ovigerous portion, which is yellowish; the pale portions are the male elements, and are irregularly lobed and of a greenish-white colour; the oviducts are short; the vas deferens was not observed. The cardiac cylinder, which is placed parallel to, but considerably below, the genital organ, is decidedly bent and has the extremities obtuse.

This rather obscure species is remarkable on account of the nearly linear arrangement of the branchial meshes, which, however, preserve sufficient curvature to bear out the character of the genus to which it belongs. It is nearly allied to *M. simplex*, from which it differs in the character of the branchial meshes already noticed, as well as in the less bushy tentacular filaments, the more voluminous intestine, and in other features of the digestive organs.

9. **Molgula citrina** Alder & Hancock.

(Pl. XXVI, figs. 5–9; Pl. XXVII, figs. 6–8; Pl. XXVIII, figs. 3–5; Pl. XL, fig. 4; Pl. XLVIII, fig. 3; and figs. 46 and 47 in text.)

Molgula citrina Alder & Hancock in Trans. Tyneside Nat. Field Club, I [1848], p. 198; [Cocks in Rep. R. Cornw. Polyt. Soc. 1849 (1850), p. 73; Norman in Rep. Brit. Assoc. for 1868 (1869), p. 303].

Body transversely ovate, convex, attached by a broad base. *Apertures*, branchial sub-terminal, slightly tubular, divided into six pointed segments, a little everted when open; anal about one-third down the body on the upper side, sub-tubular, smaller than the branchial, and divided into four less-pointed segments. *Test* nearly smooth, greenish yellow, semitransparent, deeper yellow or orange-coloured at the lower end, from the viscera showing through. *Mantle* smooth, yellow. *Tentacular filaments* pinnate. *Branchial sac* with seven folds on each side; the vessels irregularly convoluted in a double spiral, the spirals in the folds distinct, paired. *Oral lamina* narrow, not widened at the mouth. *Intestine* in a single loop. *Reproductive organs* large, wide, irregularly-formed masses.

Length three-eighths to half an inch.

Hab.—On the underside of stones between tide marks [and at low water].

England.—Cullercoats (*Alder & Hancock*) and Bamborough (*Alder*), Northumb. Whitburn, Durham (*Alder*). Douglas, Isle of Man (*Alder*). [Helford River, Falmouth, Cornwall; in trawl refuse (*Cocks*).]

Scotland.—[Lerwick, Shetland, at low water, 1861 (*Norman*).]

First record.—Alder & Hancock, 1848.

The mantle of this species (Pl. XXVII, figs. 6 and 7) is quite diaphanous, though somewhat thickened in the region of the tubes; the radiating muscles are long and delicate, passing more than half way down the sac.

The branchial sac (Pl. XXVI, fig. 8, Pl. XXVIII, figs. 3 and 4) displays well on its exterior the mouths of the branchial pouches, placed in not much curved longitudinal rows. These orifices are large, oval, and pretty equal in size, and the primary vessels are seen between them radiating backwards. The folds are rather wide, not much curved, and prettily marked by the spiral and the primary vessels; and their sides are supplied with three widish membranous rods. The spiral arrangement of the secondary vessels is not very obvious between the folds, but becomes quite distinct within them; where the spirals are placed in pairs, two pairs occupy each pouch formed or bounded by the large

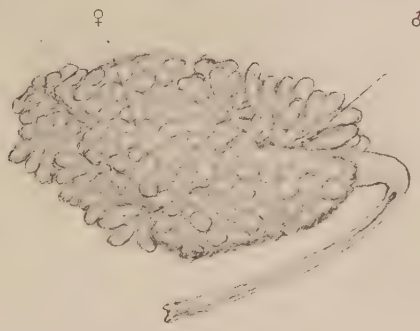


Fig. 46.—Reproductive organs of *Molgula citrina*. Magnified.

primary vessels. The oral lamina differs from that of all the other species in being of nearly equal width throughout; it is in fact rather narrower near the mouth, instead of widening as usual. The branchial tubercle (Pl. XLVIII, fig. 3) is in the form of a simple loop opening downwards. The tentacular filaments (Pl. XL, fig. 4) are twelve or fourteen in number, bipinnate, irregular in size and well developed.

The alimentary canal (Pl. XXVII, fig. 6; Pl. XXVIII, fig. 5) forms a simple loop, which, on reaching the dorsal margin, turns upwards and becomes perpendicular; the stomach is very slightly marked, being very little wider than the rest of the canal. The liver

(Pl. XXVII, figs. 6 and 7) is composed of several laminated lobules, five or six on one side and one or two on the other; the laminæ are sharply defined and the lobules more or less rounded. The border of the anal orifice is smooth and turned back.

The reproductive organs (Pl. XXVII, figs. 6 and 7, Pl. XXVIII, figs. 3 and 5, and fig. 46 in text) are large, wide, and somewhat irregularly-formed masses occupying the usual positions, one on each side of the body; the form of the right-hand organ inclines to oval, and lies against the rectal portion of the intestine, in front and above the loop. The male organ (fig. 47), which is composed of comparatively large, isolated, ovate cæca arranged in pairs, fringes the upper margin of

Fig. 47.—Male testicles of *Molgula citrina*. More highly magnified.

the ovarian mass; at the lower margin near the origin of the oviducts there is another patch of male cæca. The left-hand genital mass is subtriangular with the upper and posterior slope bordered by a similar fringe of male cæca, and at the lower side, towards the oviduct, there is also a similar belt of these cæca. The oviducts are long, narrow tubes, which, turning abruptly up in front of the organ, incline towards the atrium; they are accompanied by the vas deferens, both conduits terminating at the same point; but what is peculiar is that one of the tubes, apparently the oviduct, is entire only for a short distance, and then becomes an open deep groove, and so continues to the termination.

The cylindrical organ in connection with the heart is

situated immediately below the reproductive organ; it is large, not much bent, and rounded at the ends.

This species differs from all the others of the genus yet observed in not being clothed with extraneous substances, owing to the absence of glandular fibrils; it is also the only species except *M. complanata* which is firmly attached by its base [or side]. The external character afforded by the number of segments in the apertures, however, is well borne out by the internal; the tentacular filaments and characteristic branchiæ showing it to be a true *Molgula*.

The large ovate male cæca are also very peculiar, and in their form have much the appearance of the same organs in *Clavelina lepadiformis*.

Genus 5. **EUGYRA** Alder & Hancock, 1870.

[*Molgula* (pars) Forbes in Brit. Moll. I (1848), p. 36.]
Eugyra Alder & Hancock [in Ann. Nat. Hist. (4) VI (1870), p. 367].

Body globular, unattached, covered with glandular fibrils, and a coating, more or less complete, of fine sand. *Test* usually thin and transparent, fibrillous. *Branchial aperture* 6-lobed, *atrial* 4-lobed; placed on slight tubes, nearly inconspicuous when contracted. *Tentacular filaments* branched. *Branchial sac* without folds, but with longitudinal plates or bands, the meshes or secondary vessels regularly convoluted, each being composed of a double spiral coil meeting at the apex and produced into a little cone. *Reproductive organs* on the right side only, placed partially within the lower loop of the intestine and partially above it.

Eugyra is extremely like *Molgula* in external appearance, but differs nevertheless so greatly in internal structure, that were it retained in that genus, the characters of the latter would have to be defined much more loosely than seems either proper or convenient. Besides being distinguished by many minor points,

Eugyra is characterized by having only one genital mass, by the deficiency of branchial folds, and by the peculiar structure of the branchial tissue, the spiral arrangement of the secondary vessels of which is much more complete than in any other form; and in no other genus with which we are acquainted are the spirals composed of a double coil. Nevertheless the *Cynthia Dione* of Savigny has a branchial sac of a structure apparently similar to this, and were it not for its four-cleft aperture fringed with small filaments, might have belonged to the same genus. The right-hand ovary in that species is placed outside the intestinal flexure.

Corella on the one hand, and *Molgula* and *Eugyra* on the other, form two links in the chain of affinities uniting *Ascidia* with *Cynthia*; while each at the same time possesses characters peculiar to itself.

The test of *Eugyra* is thin and membranous and is in every respect like that of *Molgula*; it is very globular and the respiratory tubes are small and approximate.

The mantle is extremely delicate and transparent, and is provided with numerous, remote, radiating, muscular fibres, extending from the base of the tubes and all terminating in the same circular line at a short distance below; above, they are produced into the tubes, and are throughout crossed by fine, distant, circular fibres. A few detached, transverse fibres range down the ventral surface.

The branchial sac extends the entire length of the pallial chamber, and reaches almost from side to side. It is furnished on each side with seven wide, longitudinal, ribbon-like bands, which are attached by one edge to the primary or transverse vessels at the points where they cross them. These bands, how like soever in general appearance to the branchial folds in *Molgula* and *Styela*, are not to be confounded with them. They are the homologues of the longitudinal bars so constantly present in the simple Tunicata; and they give to the

surface, together with the transverse or primary vessels, which are rather conspicuous, a coarse reticulation, the square meshes of which are each occupied by a conical eminence (fig. 48). On account of the prominence of the longitudinal bands, these eminences, which look

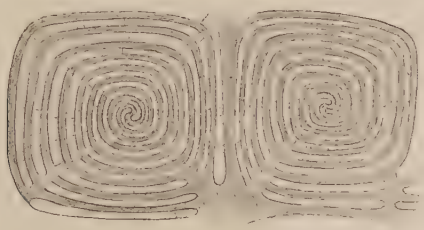


Fig. 48.—Two of the cones of the branchial sac of *Eugyra arenosa*, seen in front. Highly magnified. (Alder, in Ann. Nat. Hist. (3) XI, pl. vii, f. 4.)

like so many miniature bee-hives (fig. 49) seem to be arranged in six or seven longitudinal series, though they perhaps really compose transverse series between the primary vessels.

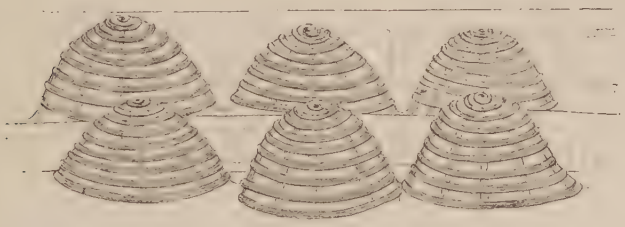


Fig. 49.—A small portion of the branchial sac of *Eugyra arenosa*, showing the cones in profile. Highly magnified. (Alder, in 'Ann. Nat. Hist.' (3), XI, pl. vii, f. 3.)

Each conical eminence is formed of a double spiral coil of secondary vessels united at the apex, so that the blood will pass up one coil and down the other. The coils are perfect, and the stomata, which are co-extensive with them, appear to be scarcely, if at all, interrupted

by inter-vascular communications. Radiating vessels, however, which are sufficiently numerous to prevent engorgement, pass from the apex of each cone to the transverse or primary vessels, and are the principal interruptions to the continuity of the spiral stomata.

The oral lamina is a plain, simple membranous band which reaches from one end to the other of the branchial sac, on the right side of the mouth; it is widest about the centre or just below the mouth, which in this genus is placed much further forward than usual, in a wide, smooth space extending along the ventral margin between the two sides of the gill. There are similar wide, smooth spaces extending along each side of the endostyle, which is almost white, and reaches from the top to the bottom of the branchial sac. The anterior and posterior cords in connection with the endostyle are well developed.

The tentacular filaments are much branched; they are about fifteen in number with one or two small ones between them.

The alimentary tube is wide throughout; it bulges from the right pallial wall into the pallial chamber, and is bent upon itself, so as to form a large transverse loop which extends to the dorsal border. After following the loop it turns downwards, and, on reaching the anterior portion of the tube, advances upwards; passing in contact with the stomach and œsophagus, it forms a second short open loop, and then terminates in the cloaca at the base of the excurrent tube.

The anus, which is large, has a wide, bilobed, reflected, papillose margin. The œsophagus is short and somewhat constricted. The stomach is wide in front, elongated downwards and backwards, and subsides gradually into the intestine so that the pyloric extremity is ill defined.

The liver is of a tawny-brown colour, and forms a compact mass which lies mostly at the ventral margin of the stomach, and is spread over the left side of that organ, partially enveloping it.

The digestive organs in *E. globosa* are similar to those of *E. arenosa* which are described above. The intestinal loop is, however, shorter than in it, and that formed by the rectal portion is so shallow that it can scarcely be said to exist. No portion of the intestine is wide, and the upper or rectal half is somewhat constricted; the liver is of a black-green colour, and forms a large subquadrate mass, entirely concealing the stomach—overlying it apparently on both its right and left sides; there is a small supplementary lobe placed in contact with, and immediately below, the principal mass.

The reproductive organs are confined to the right side; there is only one mass combining both elements. This lies on the inner or left-hand surface of the intestine, the posterior portions passing into the great, or first, or lower loop; the anterior extremity crosses the intestine and terminates in the second, shallow loop formed by the rectal portion of the tube. There is thus, when seen through the right side of the mantle, the appearance of two distinct generative masses. The female organ is an elongated sac with the posterior end doubled upon itself, and, when filled with mature eggs, is of a bright yellow colour. The testis, which is of a dull purple hue, when observed in specimens preserved in spirit, is composed of a great number of irregular, elongated vesicles or cæcal tubes, which are combined into a dense mass that enfolds and nearly conceals the posterior portion of the ovigerous sac, and overlies to a great extent the anterior portion, which is rounded in front, and, along with the ovary, abuts against the intestine a little way below the anal termination; and here the oviduct, which is a long nipple-like tube, opens into the cloaca. The reproductive organs in *E. globosa* do not differ in any important character from the above.

1. **Eugyra arenosa** Alder & Hancock.

(Pl. XXVI, figs. 10–12; Pl. XXIX, figs. 1–4; Pl. XL, fig. 5; and figs. 48 and 49 in text.)

Molgula tubulosa Forbes in Brit. Moll. I [1848], p. 36 (*pars*, excl. fig.); [Cocks in Rep. R. Cornw. Polyt. Soc. 1849 (1850), p. 73; Thompson Nat. Hist. Ireland, IV (1856), p. 360; Huxley in Carus Icon. Zootom. I (1857), pl. xviii, ff. 1–9; Dickie in Rep. Brit. Assoc. for 1857 (1858), pp. 105, 111; McIntosh in Proc. R. Soc. Edinb. V (1866), p. 605; Lecaze-Duthiers in Compt. Rend. LXX (1870), p. 1154, and in Ann. Nat. Hist. (4) VI (1870), p. 109].

[*Molgula tubularis* Thompson in Ann. Nat. Hist. (2) I (1848), p. 63; Forbes in Rep. Brit. Assoc. for 1850 (1851), p. 242.] Non *Ascidia tubularis* Rathke in Müller's Zool. Danica, IV [1806].

Molgula arenosa Alder & Hancock in Trans. Tyneside Nat. Field Club, I (1848), p. 197; Forbes & Hanley Brit. Moll. II [1849], p. 374; [Hancock in Ann. Nat. Hist. (2) V (1850), p. 196; Woodward Man. Moll. [(1856), p. 357,] (excl. fig.); [Lewes Sea-side Stud. Ilfracombe (1858), p. 91;] Alder in Ann. Nat. Hist. (3) XI [1863], p. 160, pl. vii, ff. 3, 4; [in Nat. Hist. Trans. Northumb. Durh. I (1865), p. 11; and in Rep. Brit .Assoc. for 1866 (1867), p. 208; McIntosh in Rep. Brit. Assoc. for 1867 (1868), Sect. p. 92; Norman in Rep. Brit. Assoc. for 1868 (1869), p. 302].

Body globular, hyaline, unattached, closely covered with sand, excepting generally a bright smooth area on one side. *Apertures* nearly terminal, approximated, not much produced, conical or slightly tubular, retractile; set in a small circumscribed area with a raised rim, appearing like a slit when contracted. *Test* soft, glossy, transparent and colourless, with delicate slender fibrils sometimes a little branched. *Mantle* free, except at the tubes, very thin, soft, transparent, showing the viscera very distinctly through it. *Tentacular filaments* bipinnate, beautifully spotted with bright opaque yellow. *Branchial sac* with seven longitudinal bands on each side, between which are seven rows of conical

eminences, formed of a double spiral, each of delicate vessels, meeting at the apex and giving the sac a festooned appearance. *Oral lamina* extending below the mouth, smooth, wide at the middle and narrowing above and below. *Reproductive organs* single, confined to the right side.

Diameter three quarters of an inch.

Hab.—Deepish water, in sand and mud.

England.—Cullercoats and Newbiggin, Northumb. (*Alder & Hancock* [1848]). [Northumb., Durham, and Dogger Bank (*Alder*, 1865). Ilfracombe, Devon (*Lewes*, 1858). Falmouth, Cornwall (*Cocks*, 1849).]

Wales.—[Tenby (*Lewes*, 1858).]

Scotland.—[St. Andrews, Fife (*McIntosh*, 1867).] West coast [Clyde and Hebrides] (*Forbes* [1848]). [Lochmaddy, North Uist, Outer Hebrides (*McIntosh*, 1866).] Shetland, in 40 fathoms (*Norman*), [in 20–80 fathoms (*Forbes*, 1850). Common on the haddock-grounds between Whalsey and Feltar; east of Balta; St. Magnus Bay, &c.; Shetland (*Norman*, 1868)].

Ireland.—[Ballyholme Bay, Belfast Lough, dredged from pure sand at about 6 fathoms depth, 1846 (*Thompson*, 1856), and Strangford Lough, from 7–20 fathoms (*Dickie*, 1857), Down.]

First record.—Forbes, 1848 [*coll.* Thompson, 1846].

This interesting species is far from being rare on the Northumberland coast, where it is frequently brought to shore in considerable numbers on the fishermen's lines, usually hooked singly; and occasionally they are in such abundance on a single line as to indicate that they must thickly stud the bottom of the sea in certain localities. They are always from a considerable depth and from a muddy or sandy bottom, and generally associated with *Molgula conchilega*. The fishermen call them Nelson's bullets, from their rotund form; but why Nelson's in particular is not very obvious, unless *par excellence*, he is the type of marine warfare.

Molgula tubulosa of Forbes, is, in 'British Mollusca,'

referred (we think erroneously) to the *Ascidia tubularis* of Rathke in 'Zoologia Danica.' * It is probable, however, that Forbes may have included more than one species under this name, as there are several sand-covered Ascidians which are with difficulty distinguished on a superficial examination. His description belongs to *E. arenosa*, but the figure represents the tube much longer and more cylindrical than the usual form.

As a pretty full account is given of the internal organization in the generic description, much need not be said here on the subject.

The mantle (Pl. XXIX, fig. 1), in specimens preserved in spirit, is of a purplish colour, and is so delicate and transparent that the viscera are sharply defined at the external surface. The tubes are rather slender and conical, and the radiating muscles at their base are very regularly disposed and strongly marked on account of their dark purple hue; they thicken gradually towards their lower extremities which are spread out like the rays of a fan, as all terminate at the same transverse line; but as they are not conspicuous in a fresh state it would seem that the colour may be owing to the effect of the alcohol. The tissue of the branchial sac (Pl. XXIX, figs. 2 and 3) is extremely delicate; on the external surface (Pl. XXIX, fig. 2) the primary vessels divide the spirals into transverse rows, the spirals appearing as large, hollow, oval pouches, six or seven in each row. On the inner surface (Pl. XXIX, fig. 3) the spirals project boldly into the cavity of the sac, each forming a square area defined by the longitudinal bands and primary vessels. The endostyle reaches to the bottom of the sac and has on each side a rather wide, smooth space devoid of secondary vessels. The longitudinal bands or rods are not much arched; they are wide, delicate, and membranous, and abut below on the oral lamina, which extends downwards almost to the bottom of the dorsal margin of the sac. The mouth, being placed at the

* [Forbes here referred to this species as "*Ascidia tubulosa* Rathke."]

lower extremity of the ventral margin, which is much contracted, seems as though situated about the centre of the branchial organ; it opens at the upper extremity of a wide, smooth, elongated space which reaches to the bottom of the sac.

The alimentary canal (Pl. XXIX, figs. 1 and 4) is wide and occupies the greater part of the body; it forms two loops, the lower of which is transverse and extends to the dorsal region; the upper is shallow and placed over the ventral margin. The liver (Pl. XXIX, fig. 4) is rather bulky and of a rich tawny-brown colour; the anal orifice is large and provided with a wide, reflected margin, which forms two lateral lobes; that on the left side is covered on its internal surface with clavate papillæ; the opposite lobe is smooth, but has the margin denticulated.

2. **Eugyra globosa** Hancock.

(Pl. XXVIII, figs. 5–7.)

Eugyra globosa Hancock in Ann. Nat. Hist. [(4) VI (1870), p. 367].

Body globular, unattached, [almost] entirely covered with sand and fragments of shell. *Apertures* not quite terminal, placed near together, rather wide, resembling a pair of teats, colourless, transparent, placed in a well-defined, bilobed, narrow area, devoid of attached sand. *Test* soft, thin, with very delicate and for the most part simple fibrils. *Mantle* free and only attached at the tubes, thin, colourless, or slightly tinged with yellow, transparent, the viscera showing through; tubes hyaline, with delicate membranous walls. *Branchial sac* with the vessels of the double spiral coils rather stout. *Tentacular filaments* branched. *Intestine* forming a single loop, short and constricted towards the anal extremity, and widening at its junction with the stomach. *Liver* bulky, of a very dark olive-green colour. *Reproductive organs* pale

yellow, placed partly within the intestinal loop and partly above it.

Diameter half an inch.

Hab.—?

Channel Islands.—Off Fermain Bay, Guernsey; dredged (*Jeffreys & Norman*).

First record.—Hancock, 1870; *coll.* Jeffreys & Norman [1865].

We have seen only a single individual of this species, and as the internal parts were in a bad state, notwithstanding the fine condition of the test and mantle, not much of the details has been determined. The form of the test (Pl. XXIX, fig. 5) is pretty-regularly globular, and the smooth transparent area, within which the tubes are placed, is well defined by an abrupt margin; it is a little elongated, somewhat contracted in the centre, with the ends rounded. The tubes are cylindrical, stout, and, though short, longer and much more conspicuous than they are in *E. arenosa*; they are perfectly hyaline and colourless; and are placed near together, and when fully expanded, as we are informed by Mr. Norman, are almost touching.

The mantle (Pl. XXIX, figs. 6 and 7) is free except at the tubes; it is very delicate, perfectly transparent, and almost colourless, the tinge of yellow which is perceptible being apparently caused by the internal tissues showing through. No radiating muscles are visible at the base of the tubes, nor are muscular fibres observed anywhere else in connection with the mantle. The branchial tube is nearly terminal, the atrial a short way down the ventral margin; both are wide, a little produced, and cylindrical. There is a smooth space on each side of the endostyle.

The alimentary canal forms a single loop, which extends not much more than half way across the body; a trace of a second loop is caused by the upward turn of the rectum; the lower portion of the loop, or that next the stomach, enlarges gradually forwards to its

junction with the upper or rectal portion, is much less in diameter than the lower, and at its junction with the latter it is suddenly constricted, the constriction being near the end of the loop. The liver, which is of a dark olive or blackish green, is bulky and divided into two lobes; one, much the larger, seems to envelope the stomach, the other is situated immediately below and in contact with the large mass on the right side, but is a little separated on the left. The margin of the anus is apparently smooth, but it was not distinct.

E. globosa is distinguished from its congener by the form and greater size of the tubes, by the less voluminous intestine, by the shortness of its loop, and by the dark colour of the liver.

Family 3. Cynthiadæ.

Animal simple, coriaceous, sac-formed or globose, sessile, attached or free. *Test* generally adhering to the mantle throughout. *Branchial* and *atrial apertures* 4-lobed or quadrate, sometimes appearing nearly circular when expanded; without ocelli. *Tentacular filaments* simple or compound. *Branchial sac* generally with folds, the meshes rectilinear.

Genus 6. **CYNTHIA** Savigny, 1809.

Ascidia (pars) Linnæus Syst. Nat. [I, pt. 2] (1767), p. 1087; O. F. Müller Zool. Dan. Prodr. [1776], p. 224; Fabricius Fauna Grœnl. [1780], p. 330; Lamarck Hist. Nat. Anim. sans Vert. ed. 1 [III (1816), p. 119].

Cynthia Savigny [in Descr. Égypt., Hist. Nat. I (1809), pt. 3, p. 39, and] Mém. Anim. sans Vert. pt. 2 [1816], pp. 90, 142; Dujardin in Lamarck's Hist. Nat. Anim. sans Vert. ed. 2, III [1840], p. 529; Forbes in Brit. Moll. I [1848], p. 37; Alder & Hancock in Trans. Tyneside Nat. Field Club, I [1848], p. 195; Huxley in Phil. Trans. [1851, pl. xix;] Gosse Man. Marine Zool. II [1856], p. 35; Woodward Man. Moll. [1856], p. 338; H. & A. Adams Gen. Recent Moll. I [1858], p. 591.

[?] *Pandocia* Fleming Brit. Anim. [1828], p. 468.
Glandula Stimpson [in Proc. Boston Soc. Nat. Hist. IV (1852), p. 230].

Body sessile, attached either by the base or side. *Test* coriaceous, opaque, adhering to the mantle more or less throughout. Both *apertures* quadrate or 4-lobed. *Branchial sac* with more than four folds on each side, the meshes rectilinear. *Tentacular filaments* pinnate or branched. *Stomach* and *intestine* on the right side of the body. *Reproductive organs* on both sides.

Cynthia microcosmus Savigny.

North, East, and West of Ireland, *W. Thompson* [Nat. Hist. Ireland, IV (1856), p. 361].

It is doubtful whether Mr. Thompson, who is the only one that has recognized this species as British,* may not have mistaken some other species for it. Milne Edwards says that the *C. microcosmus* of Savigny is not that of Cuvier.

1. **Cynthia rosea** Alder.

(Pl. XXXI, figs. 1 and 2; and fig. 50 in text.)

Cynthia rosea Alder in Ann. Nat. Hist. (3) XI [1863], p. 161.

Body cylindrical, nearly [two-thirds] as broad as high, rose-coloured, adhering to shells by a tolerably broad base. *Apertures* on large mamillæ, yellowish, with four double stripes of red, and covered with minute, crystalline, pointed spicula. *Test* thick, tough, opaque, smooth, [or roughened with warty tubercles,] rose-coloured, closely adhering to the mantle. *Mantle* flesh-coloured or orange, opaque. *Tentacular filaments* large, bipinnate. *Branchial sac* orange, with eight deep folds on each side. Oral lamina smooth, undulated above. *Reproductive organs* in two lobulated

* [See Dr. Dickie's record in 'Rep. Brit. Assoc.' for 1857, p. 111.]

masses; that on the right side partially within the intestinal loop.

Length about an inch and a half.

Hab.—On shells in 10 to 15 fathoms.

England.—From the Diamond trawling-ground, twelve miles off Hastings, Sussex (*Bowerbank*).

First record.—Alder, 1863; *coll.* Bowerbank.

The test of large specimens is somewhat wrinkled, and the warty tubercles are usually of a darker rose-colour than the rest of the surface; they are never crowded, and in young individuals are occasionally

Fig. 50.—Mantle of *Cynthia rosea*. One and one-third natural size.

entirely absent, when the surface is smooth. The spicula which cover the tubes are close-set and sharply pointed, and give to the surface a minutely-hispid appearance.

The mantle (fig. 50) is thick, opaque, and fleshy, with the muscular fibres close-set and regularly disposed; on the inside the fibres are strongly developed, being closely arranged in parallel order. The pallial processes are not numerous; but are unusually large and are irregularly angulated. The tubes are well produced and taper towards the extremity.

The branchial folds (Plate XXXI, fig. 1) are wide

and delicate; the primary vessels vary in size, seven or eight being much larger than the rest, and having between them usually two or three small ones; the secondary vessels are delicate. The longitudinal rods or bars are very narrow; there are six or seven on each fold and three or four between them. The oral lamina is narrow, but widens a little downwards. The branchial tubercle is large and strongly convoluted; it is placed diagonally with the convolutions inclined backwards and downwards.

The alimentary tube (Pl. XXXI, fig. 2) forms a deep, narrow loop placed across the lower portion of the pallial sac; the stomach is ill-defined, and the whole track is much obscured by the reproductive organs and the liver (Pl. XXXI, fig. 2), which latter is of a pale greenish colour, and composed of three lobulated masses attached to the left side of the œsophagus and stomach.

The reproductive organs (Pl. XXXI, fig. 2) are irregular lobulated masses; that on the left side is more consolidated than the other, and is somewhat transversely elongated; the right-hand organ is composed of several masses which encumber the looped portion of the intestine. The oviduct and vas deferens leave the ventral margins of the organs side by side; they are short tubes, the oviduct is the wider of the two, and both pass a little upwards and forwards to the base of the excurrent tube, the intestine lying between the two sets of tubes, but at some little distance from them.

2. **Cynthia claudicans** Savigny.

(Pl. XXX, figs. 1 and 2; Pl. XXXI, figs. 3–5; Pl. XL, fig. 6; Pl. XLVIII, fig. 4; and fig. 51 in text.)

Cynthia claudicans Savigny [in Descr. Égypt., Hist. Nat. I (1809), pt. 3, p. 39, and] Mém. Anim. sans Vert. [pt. 2 (1816),] pp. 90, 150, pl. ii, fig. 1 (2); [? Thompson in Ann. Nat. Hist. (1) V (1840), p. 95;] Forbes & Hanley Brit.

Moll. I [1848], p. 37; [?] Thompson Nat. Hist. Ireland, IV [1856], p. 361; [? Dickie in Rep. Brit. Assoc. for 1857 (1858), p. 111; Ansted & Latham Channel Isl. (1862), p. 219; Lansweert in Ann. Soc. Malac. Belg. III (1868), Mém. p. 115].

Body tuberous, more or less rounded, attached by a broad base. *Apertures*, branchial terminal, expanded at the margin and prettily striped with rose-colour and yellow; atrial rather distant, conical, coloured like the branchial. *Test* tough, rugose, much wrinkled in all directions, and hispid, often encrusted with zoophytes and fragments of shells; of a rosy brown above, paler below; inside shining. *Mantle* orange coloured, strongly muscular. *Tentacular filaments* doubly pinnate. *Branchial sac* with eight folds on the right side and nine on the left. *Oral lamina* small, smooth. *Reproductive organs* forming a rounded, slightly lobated mass on each side.

Diameter about an inch.

Hab.—On oysters, especially in the south (*Forbes*).

Scotland.—West Coast (*Forbes & McAndrew*).

Ireland.—[? North-east Coast (*Thompson*); and Strangford Lough, Down (*Dickie*, 1857).]

Channel Islands.—Guernsey (*Alder*).

First record.—[? Thompson, 1840].

[The test of this species is represented by fig. 1 on Plate XXX.]

The mantle is thick, opaque, and muscular; on the outer surface the various systems of fibres are distinctly seen, and on the inner they are conspicuously displayed, particularly the transverse fibres which form a beautiful close-set parallel system. The internal pallial processes are not numerous; they are large, scattered, and of an irregular form; the tubes are long.

The branchial sac (Pl. XXXI, fig. 3) has usually eight wide folds on the right side and nine on the left; but in one individual examined there were eight on both sides. Savigny says that the number varies a little, though there are always more on the left than

on the right side. The primary vessels are irregular in size; the large ones are stout and have generally a small one between them. The longitudinal rods are wider than they are in the preceding species; there are usually seven on each side of the folds, and one or two between them. The oral lamina (Pl. XLVIII, fig. 4) is narrow, a little undulated above, and it widens somewhat below, but dies gradually out by the side of the mouth. The branchial tubercle (Pl. XLVIII, fig. 4) is rather small, with the ends turned well inwards, but not convoluted; it is placed a little diagonally, being slightly inclined towards the endo-

Fig. 51. Fig. 52.

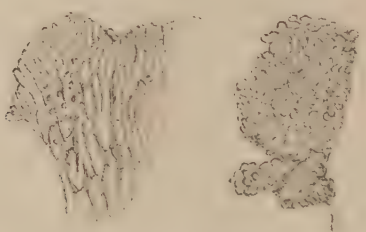


Fig. 51.—The liver in *Cynthia claudicans*. Fig. 52.—The liver in *Cynthia squamulosa*. Both magnified.

style (Pl. XXXI, fig. 5), which is rather stout and of a dark warm colour. The tentacular filaments (Pl. XL, fig. 6) are fourteen or fifteen in number, large, pretty equal in size, and regularly bipinnate.

The alimentary canal is placed towards the bottom of the pallial sac; it forms a deep close loop which passes for some distance upwards by the side of the endostyle; the stomach is not strongly defined and is obscured by the liver which is spread over its left-hand surface; the rest of the tube, with the exception of the rectal portion of the intestine, is concealed by the reproductive organs; the margin of the anus is smooth and reflected. The liver (Pl. XXXI, fig. 4, and fig. 51 in text) is of a pale yellowish-green colour, and is composed of two principal, minutely laminated, masses;

the laminæ are arranged transversely, and their edges appear at the surface like branched tubes which are beset with a few large papillæ.

The reproductive organs (Pl. XXXI, fig. 4) are large, irregularly-rounded masses; that on the left side is composed of a congeries of rounded ovigerous lobules having in the interstices clusters of male cæca. On the right side there is a similar mass of ovigerous lobules and sperm-vesicles lying above the looped portion of the intestine; and between this mass and the endostyle, overlying the dorsal limb of the loop, is a dense mass of male cæca, which are large, short, obtuse, and united in pairs. The oviduct and vas deferens are short and united so as to appear as a single stoutish tube, but open through separate nipple-like orifices; that of the oviduct has the orifice four-cleft, and is somewhat larger than the male outlet. These ducts extend from the ventral margin of the genitalia, and stretch towards the excurrent orifice at some little distance on each side of the anus.

Cynthia claudicans appears to be a southern form and has not yet been found on the North and East coasts of Great Britain. There may be some doubt whether the locality "North of Ireland" given by Mr. Thompson is correct, as the species is not in his collection. Specimens of the allied form *C. squamulosa* Ald. were found in it, and without name but labelled "Strangford and Belfast Loughs." This latter species (which was undescribed at the time) is not noticed in his Catalogue, and it is probable that he mistook it for *C. claudicans*.

3. **Cynthia squamulosa** Alder.

(Pl. XXX, fig. 3; Pl. XXXI, figs. 6–8; Pl. XXXII, figs. 1 and 2; Pl. XL, fig. 7; Pl. XLVIII, fig. 5; and figs. 52 and 53 in text.)

Cynthia squamulosa Alder [MS. sp. in Ansted's Channel Isl. (1862), p. 219;] in Ann. Nat. Hist. (3) XI [1863], p. 161; [and in Rep. Brit. Assoc. for 1866 (1867), p. 208].

Body ovate or subglobose, of a pinkish hue tinged with lilac, attached by a broad base. *Apertures* a little apart, rather large and conical, but not much produced; the branchial terminal, the atrial nearly so, each margined and rayed with violet. *Test* tough, smooth or slightly mamillated, covered with small scaly plates [which are marked with concentric lines], silvery inside. *Mantle* very thin and delicate, transparent, pale rose-coloured, with fine longitudinal muscular fibres crossed by irregular transverse ones. *Tentacular filaments* slender, simply pinnate. *Branchial sac* bright rosy orange, with six folds on each side. *Ovaries* forming a double, linear, perpendicular series of yellowish-white globular masses on each side, with a fimbriated mass of dark reddish sperm-cells between.

Diameter from half an inch to an inch.

Hab.—On shells, etc. (dredged in about 15 fathoms at Guernsey).

England.—Hastings, Sussex (*Bowerbank*). Lulworth Cove, Dorset (*Jeffreys*).

Scotland.—Shetland (*Jeffreys*).

Ireland.—Birterbuy Bay, Connemara, Galway (*Brady*). [See also p. 81.]

Channel Islands.—Guernsey (*Alder*).

First record.—Alder, 1863; *coll.* 1853.

The test (Pl. XXX, fig. 3) though tough and hard is not very thick; the scales covering it vary in size and shape and are many-sided. In old specimens they are occasionally a little elevated, giving to the surface a mamillated appearance; they form a complete pavement, the margins lying in close contact.

The mantle (Pl. XXXII, figs. 1 and 2) is delicate and adherent to the test; the longitudinal muscular fibres are placed considerably apart, and radiate in regular order from the apertures; the transverse fibres are delicate, and are less-regularly disposed. The inner surface of the mantle is peculiar for the vast number of minute fleshy nodules which clothe it, and

amidst which the viscera are partially immersed. These pallial nodules are developed also on the surface of the reproductive organs, filling up in a great measure the depressions between the various parts, and likewise insinuating themselves amidst the hepatic lobules; they are very irregular in form, some being rounded, others elongated and even produced into points and angles.

There are six folds on each side of the branchial sac (Pl. XXXI, fig. 6); the anterior ones are the shortest, the posterior pair are narrower than the rest and diminish in width downwards. The primary vessels are alternately large and small, and the stomata are long with the small intermediate primary vessels crossing them. The longitudinal rods are rather

Fig. 53.—A bi-pinnate tentacular filament of *Cynthia squamulosa*. Highly magnified.

narrow; there are six or seven on the folds and three or four between them. The tentacular filaments are large, vary in size, and are usually simply pinnate (Pl. XL, fig. 7), but occasionally show a tendency to become bi-pinnate (fig. 53). The branchial tubercle (Pl. XLVIII, fig. 5) is small and forms a simple loop opening upwards. The oral tentacles are minute and are twenty-eight or thirty in number, and compressed a little from back to front.

The alimentary tube forms a simple transverse loop, extending almost across the pallial sac, and is pretty equal in calibre throughout; the stomach is elongated and very slightly enlarged, and the rectal portion, which is turned forward, is short and a little reduced in diameter; the margin of the anus is smooth. The liver (Pl. XXXI, fig. 7, and fig. 52 in text) is well

developed, and extends over the left side of the stomach; it is composed of two lobes, one being larger than the other, and is broken up into irregular lobules which are composed of minute dendritic tufts the cæcal extremities of which give to the surface of the organ a pimpled appearance.

The reproductive organs (Pl. XXXI, fig. 7) form two elongated masses, each composed of a double series of rounded lobes or masses attached in regular order along the excretory ducts (Pl. XXXI, fig. 8). The ova are placed in the proximal extremity of the lobes, the sperm-vesicles, which are distinguished by their large size and pale colour, at the distal or outer extremity.

We first met with this pretty species in Guernsey in 1853. It has since been sent to us from Lulworth Cove by Mr. Jeffreys, and it was also dredged in the Channel Islands by Messrs. Jeffreys and Norman in 1865. [Other localities are given on p. 82.]

4. **Cynthia ovata** *sp. nov.*

(Pl. XXX, figs. 4 and 5; Pl. XXXII, figs. 3–5; Pl. XXXIII, fig. 1; and figs. 54 and 55 in text.)

Body regularly ovate, inflated, smooth, yellowish white, deepening into fawn colour towards the apertures; largely attached by the left side or near the back. *Apertures* wide apart; the branchial terminal, the atrial about three quarters down, or near the base; both rather prominent. *Test* thin but tough, regularly and delicately squamose. *Mantle* thin and transparent, flesh-coloured, covered with fine interlacing muscular fibres. *Tentacular filaments* simply pinnate, about fifteen, nearly of equal length. *Branchial sac* with six folds on each side. *Oral lamina* with filaments. *Reproductive organs* forming a double row on each side; those of the left side enclosed within the loop of the intestine.

Length nearly an inch; *breadth* one third less.

Hab.—Adhering to shells.

Channel Islands.—Guernsey; dredged (*Jeffreys & Norman*).

First record.—Alder & Hancock; *coll.* Jeffreys & Norman.

A beautiful and very distinct species (Pl. XXX, figs. 4 and 5). It was adhering to the inside of an old bivalve shell—*Cyprina islandica.*

The mantle (Pl. XXXII, figs. 3–5, and fig. 54 in

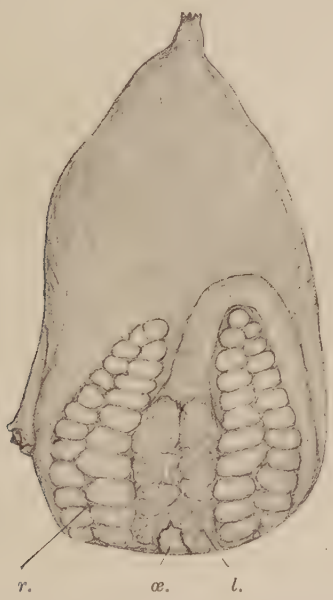


Fig. 54.—The mantle of *Cynthia ovata.* Three times natural size. *l.* Liver. *œ.* Œsophagus. *r.* Reproductive organs, ♂ and ♀.

text) is delicate, with the muscular fibres fine, regularly disposed and placed considerably apart, the encircling ones being more conspicuous than those radiating from the tubes; the inner pallial processes or tubercles are not numerous, but vary in form and size.

The branchial folds (Pl. XXXIII, fig. 1) are narrow; the primary vessels pretty-regularly large and small; the stomata are linear and rather long with the extremities rounded; there are four longitudinal rods

on the folds, and three or four between them. The branchial tubercle is loop-formed with the extremities turned inwards. The oral tentacles, which are numerous, are flattened from back to front.

The alimentary canal forms a simple loop which extends half way up the pallial sac; the stomach is elongated and a little widened, and has the liver (fig. 55, p. 88) overlying the left side; the latter organ is divided into several lobules which are composed of short, tubular, slightly-branched processes.

The reproductive organs (Pl. XXXII, figs. 4 and 5, and fig. 54 in text) are two elongated masses each composed of a double series of rounded or oval lobes arranged in close order along the excretory ducts, which extend as a compound tube a little in front of the organ, and terminate in two nipple-formed orifices in the vicinity of the anus.

5. **Cynthia morus** Forbes.

Pl. XXX, figs. 6 and 7; Pl. XXXIII, figs. 2–5; Pl. XL, fig. 8; Pl. XLVIII, fig. 6; and fig. 56 in text.)

Cynthia morus Forbes in Brit. Moll. I [1848], p. 39, pl. D, f. 2; [Carus in Proc. Ashmol. Soc. II (1851), p. 267; Forbes in Brit. Assoc. Rep. for 1850 (1851), p. 242; H. & A. Adams Gen. Recent Moll. II (1858), pl. cxxxiii, f. 3; Ansted & Latham Channel Isl. (1862), p. 219; Grube in Abh. Schles. vaterl.-Cultur, 1868–69 (1869), pp. 112, 125].

[*Cynthia moreus* Cocks in Rep. R. Cornw. Polyt. Soc. 1849 (1850), p. 72.]

[*Cynthia mora* Dickie in Rep. Brit. Assoc. for 1857 (1858), p. 111.]

Body transversely oblong or ovate, attached throughout the length of its base, rose-red, covered with large close-set rounded tubercles, giving it a raspberry-like appearance. *Apertures* far apart, forming short and broad tubes, yellowish, with four double stripes of red. *Test* thick and tough. *Mantle* flesh-coloured with a

band of rose-colour or crimson around each aperture. *Tentacular filaments* pinnate. *Branchial sac* with seven folds on each side, six of which are large and deep, that near the dorsal line small. *Ovaries* forming botryoidal masses on each side, with a fimbriated orange mass of sperm-cells between.

Length three quarters of an inch; *height* about one-third less.

Hab.—On shells and stones (in 25 fathoms water in Mount's Bay).

England.—Lulworth Cove, Dorset (*Jeffreys*). [Devon (*Forbes*).] Polperro (*Loughrin*); Fowey Harbour (*Peach*); [Bar Point and Helford River, Falmouth (*Cocks*, 1849);] and Mount's Bay (*Forbes & McAndrew*); Cornwall. [Scilly Isles (*Carus*, 1850).]

Ireland.—[Strangford Lough (*Dickie*, 1857).]

Channel Islands.—Guernsey (*Alder*).

First record.—Forbes, 1848.

The test of this pretty species (Pl. XXX, fig. 6) is hard and tough; when contracted in spirit it has a strongly-wrinkled, tubercular, and scaly aspect, and on careful examination each tubercle is found to be covered with a largish scale, thus showing that *C. morus* belongs to the tessellated group, with which it agrees in all other respects.

The mantle (Pl. XXX, fig. 7) is thick and fleshy with the muscular fibres more closely arranged than is usual in the members of this section, and there is a strong muscular fold at the base of each tube; the tubes are cylindrical.

The branchial sac (Pl. XXXIII, fig. 2) has seven moderately-wide folds on each side; that next the endostyle is narrowest. The primary vessels are pretty-regularly alternately large and small; they are placed rather close together, and on the folds there are usually intermediate minute ones; the secondary vessels are short, and the stomata are elliptical. The longitudinal rods are rather wide; there are eight or

nine on each side of the folds and four between them. The tentacular filaments are pinnate, of nearly equal size, and number twenty-four or twenty-five. The branchial tubercle (Pl. XLVIII, fig. 6) is large, transversely oval, and strongly convoluted, the convolutions being directed upwards. The oral lamina (Pl. XL, fig. 8) is broken up into about twenty-five tentacular processes which are attenuated, sharp at the points, and much inflated at the base, and are supported on a narrow membranous ridge.

The alimentary canal (Pl. XXXIII, fig. 3) forms a single open loop which extends from the bottom of the pallial sac for more than two-thirds the length of

FIG. 55. FIG. 56.

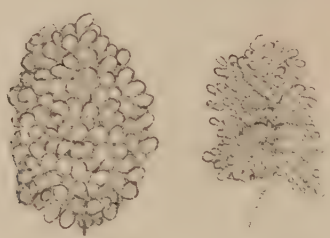


FIG. 55.—The liver in *Cynthia ovata*. FIG. 56.—The liver in *Cynthia morus*. Magnified.

the endostyle; the calibre of the tube is pretty-equal throughout, the stomach being scarcely distinguishable. The liver (Pl. XXXIII, fig. 3 and fig. 56 in text) is well developed and is composed of three or four lobed masses, which when in a fresh state are of an orange colour, but when preserved in spirit are of a pale greenish yellow; the masses are made up of dense dendritic tufts, the extremities of the branches of which, extending upwards, give to the surface of the organ a minutely-papillose appearance; in this branched and dendritic structure the organ is very similar to that of many of the Brachiopods.

The reproductive organs (Pl. XXXIII, figs. 3–5) are rather voluminous, and are composed of congeries

of rounded nodules; that on the left side is placed immediately above the intestinal loop, and is somewhat pyriform with the wide end forward or inclined on the ventral margin; the right-hand organ is situated on the loop of the intestine and is irregularly oval. The nodules (Pl. XXXIII, figs. 4 and 5) composing the organs are compound, comprising both male and female elements; they are pyriform and pedunculate, with the sperm-cells placed at the broad end and the eggs at the narrow; the sperm-cells are large, ovate, and obtuse. The interstices of the reproductive nodules are for the most part filled up with irregularly-formed bodies, apparently modified pallial processes, none of which are found in any other part of the pallial wall.

When contracted in spirits, the test of *Cynthia morus* has a strongly wrinkled and scaly aspect, very different from its attractive appearance in a fresh state.

6. **Cynthia tessellata** Forbes.

(Pl. XXX, figs. 8 and 9; Pl. XXXII, figs. 6 and 7; Pl. XXXIII, figs. 6 and 7; Pl. XLVIII, fig. 7; and figs. 57 and 58 in text.)

Cynthia tessellata Forbes in Brit. Moll. I [1848], p. 38, pl. D, f. 3; [Cocks in Rep. R. Cornw. Polyt. Soc. 1849 (1850), p. 72; Forbes in Rep. Brit. Assoc. for 1850 (1851), p. 242; Ansted & Latham Channel Isl. (1862), p. 219; Alder in Rep. Brit. Assoc. for 1866 (1867), p. 208].

Body transversely ovate, rather depressed, tawny-yellow with darker spots, attached by an expanded base. *Apertures* distant, tubular, purple. *Test* coriaceous, tessellated by regular oblong spaces, generally hexagonal, and concentrically ridged, with a dark reddish or purplish centre, the lower or attached surface very thin without markings. *Mantle* thin, rosy flesh-coloured spotted with white. *Tentacular filaments* pinnate or sub-bipinnate. *Branchial sac* with three or four folds on each side. *Oral lamina* with filaments.

Ovaries forming a linear series on each side, with spermatics (?) or liver (?) between.

Length half to three quarters of an inch; *breadth* one third less.

Hab.—On shells and stones, from about 15 to 25 fathoms.

England.—Lulworth Cove, Dorset (*Jeffreys*). [Devon (*Forbes*). Falmouth; in trawl refuse (*Cocks*, 1849); and] Mount's Bay (*Forbes & McAndrew*); Cornwall.

Scotland.—Hebrides (*Jeffreys & Norman*).

Channel Islands.—Guernsey; dredged (*Norman*). Near Castle Cornet, Guernsey (*Alder*).

First record. — Forbes, 1848; *coll.* Forbes & McAndrew, 1846.

In form this species resembles a *Patella*, or is somewhat doridiform. The test (Pl. XXX, fig. 8) is firm, hard, and coriaceous, moderately thick and convex above; flat, colourless, soft, and comparatively thin at the under or attached side, with the marginal border expanded; the inner surface shines with a metallic lustre.

The mantle (Pl. XXXII, figs. 6 and 7) is thick and fleshy, and is attached throughout, but is usually found detached in spirit specimens, though never shrunk up as in the *Ascidiæ*; on the contrary it completely fills the interior of the cavity, hence it is evident that the separation took place after death from the influence of the spirit. The muscular fibres are a little separated and are regularly arranged. At the base or attached side they are comparatively feeble, and seem mostly disposed in a radiating manner; above they are stout and radiate from the orifices, and are crossed by numerous minute fibres. A few angular pallial nodules are situated in the vicinity of the endostyle.

The branchial sac (Pl. XXXIII, fig. 6) is very delicate and has four folds at each side; the anterior pair is short, the posterior narrow. The primary vessels are irregular in size and have frequently a

fine one between them; the secondary vessels are rather long and delicate, the stomata have the extremities rounded; there are about six longitudinal bars on the folds, and three or four between them. The oral tentacles (fig. 57), of which there are between

Fig. 57.—Oral tentacles of *Cynthia tessellata*. Highly magnified.

twenty and thirty, are long, slender, nearly cylindrical, and finely pointed; they are placed along a narrow ridge, and increase in length as they approach the mouth. The branchial tubercle (Pl. XLVIII, fig. 7) is minute and of an ovate form, placed longitudinally; no convolutions were observed. The tentacular filaments (fig. 58) are about twenty in number, and are alternately large and small; they are somewhat distant, usually pinnate, long, and slender; but as the pinnæ occasionally bifurcate or branch they may be considered imperfectly bi-pinnate.

Fig. 58.—A tentacular filament of *Cynthia tessellata*. Highly magnified.

The alimentary canal (Pl. XXXIII, fig. 7) forms a simple, open loop of nearly equal calibre throughout; the stomach is scarcely indicated, except by the presence of the liver, which is composed of two masses, formed of numerous branched lobules, sometimes having the appearance of folds or plaits; they

are, however, similar in character to the dendritic tufts of the preceding species (*C. morus*); but the parts are much coarser, and the branches shorter. Two peculiar hair-like processes extend some distance adherent to the intestine; these open into the stomach, and would seem to be part of the hepatic organ. The intestine is as wide as the stomach, but the rectal portion is a little contracted towards the anus, the margin of which is smooth.

The reproductive organs (Pl. XXXIII, fig. 7) are composed of two nodulose belts, the right-hand one lying within the intestinal loop, the left along by the side of the endostyle. The nodules are large and angular, and vary much both in form and size; they are strung together on a widish band, within which run the excretory canals. The latter are continued a little in advance of the ventral extremity of the nodulose belt as a compound tube which terminates at the sides of the anus in two distinct outlets. There are, therefore, four reproductive outlets, two on each side of the intestine.

Some little difference will be found between the description and figure of *Cynthia tessellata* here given and those of Professor E. Forbes. Our specimens are somewhat intermediate in character between his *C. tessellata* and *C. limacina*, but agree more nearly with the former, to which we have referred them.

7. **Cynthia limacina** Forbes.

Cynthia limacina Forbes in Brit. Moll. I [1848], p. 39, pl. D, f. 4; [Carus in Proc. Ashmol. Soc. II (1851), p. 267; Ansted & Latham Channel Isl. (1862), p. 219].

Body much depressed, expanded, doridiform. *Test* coriaceous, orange with dark brown reticulated markings, enclosing numerous small, depressed warts of various sizes; orifices quadrangular, papillose, almost sessile, brown.

Length three-quarters of an inch.

Hab. — On a dead shell in 25 fathoms water (*McAndrew & Forbes*).

England. — [? Hastings, Sussex (*Bowerbank*).] Mount's Bay, Cornwall (*McAndrew & Forbes*). [Scilly Isles (*Carus*, 1850).]

Channel Islands.—[Guernsey (*Austed*, 1862).]

First record.—Forbes, 1848; *coll.* McAndrew & Forbes, 1846.

A specimen sent to us from Hastings by Dr. Bowerbank appears to belong to this species. The body is extremely depressed and nearly flat, with the basal margin sinuous. The test is soft and pellucid in comparison with that of *C. tessellata*, and the tessellations are only about half the size of those of that species, and are shorter, rounder, and less regular. There was no colour remaining. The visceral characters could not be determined as they had been injured by pressure. The mantle, however, is thin, transparent, and membranous, and adheres strongly to the test throughout; the muscular fibres are excessively fine.

8. **Cynthia echinata** (Linnæus) Alder.

(Pl. XXX, fig. 10; Pl. XXXII, fig. 8; Pl. XLVIII, fig. 8; and fig. 59 in text.)

Ascidia echinata Linnæus Syst. Nat. ed. 12, [I, pt. 2 (1767),] p. 1087; [P. Müller Linné Natur-Syst. I, 1 (1775), p. 86;] O. F. Müller Zool. Dan. Prodr. [1776], p. 224, no. 2722, and Zool. Danica, IV [1806], p. 10, pl. cxxx, f. 1; Fabricius Fauna Grœnl. [1780], p. 331; [Bruguière Hist. Nat. Vers, I (1789), p. 147; Gmelin Linnæi Syst. Nat. I, pt. 6 (1791), p. 3124; Bosc Hist. Nat. Vers, I (1802), p. 104; Turton Gen. Syst. Nat. IV (1802), p. 93;] Lamarck Hist. Nat. Anim. sans Vert. [ed. 1, III (1816), p. 123, and] ed. 2, III [1840], p. 528; [Thompson in Ann. Nat. Hist. (1) V (1840), p. 94;] Forbes & Hanley Brit. Moll. I [1848], p. 35 [pl. C, f. 4]; [Cocks in Rep. R. Cornw. Polyt. Soc. 1849 (1850), p. 73;] Thompson Nat. Hist. Ireland, IV [1856], p. 360; [Norman in Zoologist XV (1857), p. 5708; Dickie in Rep. Brit. Assoc. for 1857, (1858), p. 111].

Cynthia echinata [Alder in Trans. Tyneside Nat. Field Club, I (1850), p. 362; Forbes in Rep. Brit. Assoc. for 1850 (1851), p. 242; Stimpson Invert. Grand Manan (1854), p. 20; Schultze in Arch. f. mikr. Anat. XII, 2 (1862), p. 178;] Alder in Ann. Nat. Hist. (3) XI [1863], p. 162, [and in Rep. Brit. Assoc. for 1866 (1867), p. 208; Packard in Mem. Boston Soc. Nat. Hist. I (1867), p. 277; Norman in Rep. Brit. Assoc. for 1868 (1869), p. 303; Agassiz in Gould's Rep. Invert. Massachusetts, ed. 2 (1870), p. 18, pl. xxiii, f. 326].

[*Ascidium echinatum* Woodward Man. Moll. (1856), p. 337.]

Body globose, hispid, adhering by a small base. *Apertures* sessile, approximated, rayed with four double lines of crimson. *Test* opaque, yellowish white, tough, mamillated; each eminence crowned with a tuft of large branched and stellate hairs; the whole of the surface is also seen, under a magnifier, to be minutely hispid; inner surface silvery. *Mantle* pale flesh-coloured. *Tentacular filaments* branched, bi- or tripinnate. *Branchial sac* with six folds on each side, four deep and two shallow; the meshes transverse. *Ovaries* in solid masses.

Diameter about three quarters of an inch.

Hab.—On shells, on zoophytes, [and on the larger *Ascidiæ*,] in deep water [and occasionally in shallow water].

England.—Cullercoats, Northumb. (*Alder*). Whitburn (*Alder* [1850]), and Seaham Harbour (*Hodge*), Durham.

Scotland.—Peterhead, Aberdeen (*Peach*). Oban, Argyll (*Alder*). Hebrides (*Jeffreys* [; *Forbes*]). Shetland (*Forbes & Goodsir*). [Middle Haaf and Brassey Sound, Shetland, in 5 to 40 fathoms, 1863, and 5 to 8 miles east of Balta, in 40 to 50 fathoms, 1867 (*Norman*, 1868).]

Ireland. — Strangford Lough, Down (*Thompson* [1840]).

First record.—Forbes & Hanley, 1848; [*coll.* Forbes & Goodsir, 1837].

[The test of this species is represented by fig. 10 on Plate XXX.]

The mantle (Pl. XXXII, fig. 8) is firmly attached to the test, particularly in the region of the tubes, and the tubes themselves cannot be withdrawn without laceration; it is rather thin, tough, and transparent; the muscular fibres are delicate and regularly arranged, somewhat apart; those radiating from the tubes being the best displayed; the inner surface seems to be devoid of the usual soft nodules. The tentacular filaments (fig. 59), about sixteen in number, are alternately large and small, rather long and slender, and incompletely tri-pinnate.

The branchial sac is delicate with five folds on each

Fig. 59.—A tentacular filament of *Cynthia echinata*. Highly magnified.

side, four of which are well developed, and one, that next the endostyle, is narrow. The blood-channels are peculiarly arranged. Stout longitudinal vessels pass with much regularity from end to end of the organ, and, but for this arrangement, would be taken for primary vessels; and other small vessels having the appearance of secondary vessels, divided by stomata, are placed transversely between the large ones; the stomata are long with rounded extremities. The small vessels in this case must conduct the blood from the dorsal to the ventral channel and consequently act as primary vessels; while at the same time the chief aeration must take place through their walls, for here the blood is the most minutely divided. Nevertheless from their anatomical connections they should perhaps

be considered the homologues of the primary vessels. The longitudinal rods are wide and numerous, there being eight or nine on the folds, and three or four between them; they are attached to the small transverse vessels. The endostyle is wide, delicate, and soft. The branchial tubercle (Pl. XLVIII, fig. 8) is small with the extremities turned inwards or only slightly convoluted, and is widened transversely. The oral filaments or tentacles (Pl. XLVIII, fig. 8), from twenty to thirty, are placed on a ridge; they are small, not compressed, and have their points attenuated. The alimentary canal forms a loop which extends nearly the length of the pallial sac; the calibre is about equal throughout; the stomach is chiefly distinguished by the presence of the liver, which is of a pale greenish colour, and divided into two unequal, dense, irregular, lobes; its minute structure is composed of small, branched tubules, closely packed together and enveloped in a common delicate membrane. The border of the anus is smooth.

The reproductive organs are two irregularly-elongated, dense, and somewhat lobed masses, containing both elements; the ducts issue from the anterior extremity; they are short, somewhat reflected, and stand up from the surface of the mantle. The right-hand mass lies within the intestinal loop; the left near to the endostyle.

Professor E. Forbes mistook this species for an *Ascidia*. His figure in consequence represents the apertures with too great a number of segments. There are certainly only four in each orifice.

The beautiful star-like hairs of the test (see Pl. XXX, fig. 10), best seen in adult and well-developed specimens, distinguish this interesting species from its congeners. It is also peculiar in the arrangement of the meshes of the branchial sac, the smaller vessels of which are here transverse, while, with one exception, in all the other known species of the genus as well as in those of *Ascidia*, they are

longitudinal. The exception alluded to is the *Cynthia villosa* of Stimpson from Puget Sound, in which we have found the meshes transverse in the same manner as in *C. echinata*. It also resembles this species a good deal in other respects. The fibres of the test, however, are slightly branched and not stellate, and the branchial folds are seven on each side.

Cynthia echinata is a northern species, not uncommon in the seas of Norway and Greenland. We have yet no record of its occurrence in the South of England. It is found in North America (*Sars*).

Genus 7. **STYELA** (Savigny) MacLeay, 1825.*

[*Distomus* (pars) Gaertner in Pallas' Spic. Zool. I, fasc. 10 (1774), p. 24.]
[*Ascidia* (pars) Pallas Spic. Zool. I, fasc. 10 (1774), p. 24.]
[*Cynthia* (pars) Savigny in Descr. Égypt., Hist. Nat. I (1809), pt. 3, p. 39.]
Cynthiæ Styelæ Savigny Mém. Anim. sans Vert. pt. 2 [1816], p. 154.
[*Styela* MacLeay in Trans. Linn. Soc. Lond. XIV (1825), p. 546.]
Stycla Menke [Synops. meth. Moll. (1830), p. 122].
[*Phallusia* Schacht in Arch. f. Anat. 1851, p. 178.]

Body sessile, attached or sometimes free. *Test* coriaceous, generally rough and opaque, adhering to the mantle throughout. Both *apertures* quadrate or 4-lobed. *Branchial sac* with only four folds on each side, the meshes rectilinear. *Tentacular filaments* simple, linear. *Stomach* and *intestine* on the right side of the body. *Reproductive organs* variable, situated on both sides.

In the account of the anatomy of this genus we shall rely principally on that of *S. tuberosa* and *S. mamillaris*, not only on account of their large size, but also because they are good typical species. In these two forms the test is very tough, opaque, and coriaceous. The surface

* This genus appears in the authors' MS. as "*Stycla* (Savigny) Menke," but, as stated in the footnote on p. 19 of Vol. I, this is an error for *Styela*.

is much corrugated, particularly in *S. mamillaris*, on which parasitic growths are very frequent. It is strongly adherent to the mantle or inner tunic. The internal surface is very smooth and has almost a silvery-white appearance, varied in parts with a rosy hue. It readily divides into two layers; the inner layer is delicate and liable to be left adhering to the mantle.

The mantle is likewise comparatively thick and tough, and is so opaque that the arrangement of the muscular fibres is not readily distinguished. In *S. mamillaris*, however, delicate, longitudinal fibres can be traced passing from above downwards. The viscera are completely obscured in both species. In *S. tuberosa*, the mantle is of a pale flesh colour; in *S. mamillaris* it is of a neutral green hue suffused with scarlet in the region of the tubes. The former animal is elongated and pyriform; the latter is irregularly oval transversely.

The aerating surface of the branchial sac is composed of a minute rectilinear reticulation of primary or transverse and minute secondary vessels, and on each side of the oral lamina there are four wide folds which stretch from one end of the sac to the other. The network is in other respects as simple as it is in *Ascidia venosa*. The folds all terminate below in the vicinity of the mouth, drawn as it were into a focus; but as the mouth is placed considerably up the ventral side, all the folds are much arched backwards and downwards in conformity with the line of the endostyle, those nearest to that organ being most curved; the lower portion of the folds, in fact, have to ascend to reach their terminal position by the side of the mouth.

The longitudinal bars are represented in *Styela* by numerous, fine, ribbon-like membranes which extend the whole length of the branchial sac; they are placed at some little distance apart, and are as numerous on the folds as they are between them.

The oral lamina is a broad, smooth membrane, passing from the branchial tubercle to the right side

of the mouth. It is widest about the middle, and narrows considerably at the ends. The branchial tubercle is a large, oval, smooth boss with the convoluted ends turned downwards, and, meeting below, very little involuted.

The tentacular filaments are numerous, long, and slender, and are placed not much below the margin of the branchial sac.

The heart is a long, narrow tube, lying between the mantle and the lining membrane on the left side, at some little distance from the lower dorsal margin of the branchial sac. It is placed, as usual, in a cavity of its own—a sort of pericardium. The dorsal extremity reaches the endostyle much higher up than usual; and the ventral extremity abuts against the lower margin of the cardiac end of the stomach, and gives a large branch to each side of that organ. The vessels supplying the test are small, and in *S. mamillaris* enter it farther forward than is usually the case.

The ganglion of the nervous system is situated immediately below the branchial tubercle; but on account of the opacity of the inner tunic it is difficult to trace the nerves.

The alimentary tube of *S. tuberosa* is short and very simple in its arrangement. It protrudes from the inner wall of the right side of the pallial cavity, towards the ventral margin. The mouth is a circular orifice and is bordered with a widish, puckered, lip-like, expansion; it opens into the branchial sac some way up the ventral margin, the posterior extremity of the sac passing backwards considerably beyond it. The œsophagus is short and constricted; it extends backwards or downwards to the stomach, which is well marked though not large, and is regularly elliptical. The intestine passes backwards and downwards from the lower end of the stomach, and then, turning upwards, forms a widish vertical loop next the ventral margin; it then slopes gradually towards that margin in a gentle sigmoid curve, and, on reaching the cloaca,

Univ. of Arizona Library

considerably in advance of the level of the mouth, terminates in a wide anal orifice bordered with a broad, reflected, lobed, margin. The looped portion of the intestine is wider than the rectal portion, and its walls are delicate and membranous. A thick mucous membrane lines the whole alimentary tube. In the stomach it is thrown into rugæ which can be observed from the outside as narrow, opaque, yellowish lines sloping forwards and outwards from the centre of the organ. The lining membrane of the intestine is raised into a strong ridge which extends the whole length of the tube, and is seen through the left wall as a broad dark groove-like line.

The liver in *Styela* is not more conspicuous than it is in *Ascidia*; and it shows about the same degree of development, being provided with its secreting vesicles and ducts, only slightly modified from those of that genus. In *S. tuberosa*, and indeed in all the members of this group which have come under our observation, there is a fold of the lining membrane within the loop of the alimentary tube, which passes between the stomach and intestine. This fold is united to the pyloric end of the stomach, where there is a cæcal prolongation of that organ. The hepatic ducts lie within this fold, and before they reach the stomach, in this species, they unite to form a simple, slender duct, which opens into the left side of the cæcum. The branches of the ducts ramify dichotomously over the looped portion of the intestine, and communicate with comparatively-large, round vesicles arranged like those of *Pelonaia*.

The alimentary tube in *S. mamillaris* differs from that of *S. tuberosa* in some unimportant particulars. The œsophagus is much longer, and the stomach is placed transversely almost at the bottom of the pallial chamber. The intestine runs backwards and nearly extends as far as the dorsal border of the chamber before it ascends to form a wide transverse loop; it then crosses to the cloaca, making a deep sigmoid curve, and terminates at a little distance above the

position of the mouth in a large anal orifice, fringed with a denticulated margin. The rectal portion is short and not much diminished in calibre.

The reproductive organs beset both sides of the mantle, from which they jut prominently into the pallial chamber. In *S. tuberosa* they are very numerous, and are in the form of irregular, pyriform nodules, of a bright orange colour, distributed without apparent order, excepting that the attenuated end is mostly directed upwards and towards the ventral margin.

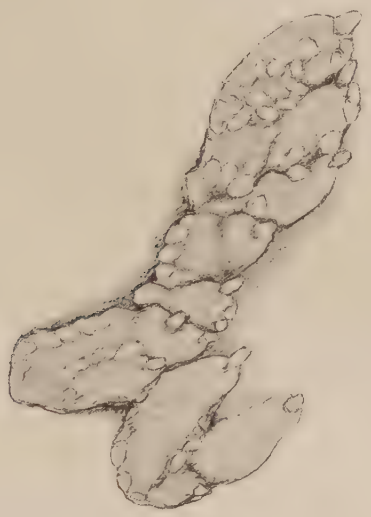


Fig. 60.—Reproductive organs of *Styela tuberosa*. Magnified.

These are the so-called ovaries, but they are really compound bodies combining both the male and female organs. The centre and larger portion of each is a sac, in the walls of which the ova are developed; and the narrow extremity is produced into a short, nipple-like oviduct, leading directly out of the sac. And firmly attached around the base of each is a series of small, oval vesicles, which are sunk in the substance of the mantle, and which form for each sac a sort of basal cup, within which they rest. These are the male secreting organs, and their ducts, extremely delicate

tubes, frequently united in pairs, pass upwards over the surface of the ovigerous sac, and go to join, on the median line, a slender vas deferens, which, passing forward, terminates at the extremity of the oviduct. There are thus as many oviducts and outlets for the male secretion as there are compound reproductive masses, and the eggs must be shed everywhere into the atrial space between the branchial sac and the wall of the pallial chamber, and afterwards carried by the atrial currents to the cloaca, whence they pass out as usual by the excurrent tube.

Besides the reproductive masses other very similarly-formed bodies everywhere stud the mantle, and fill up

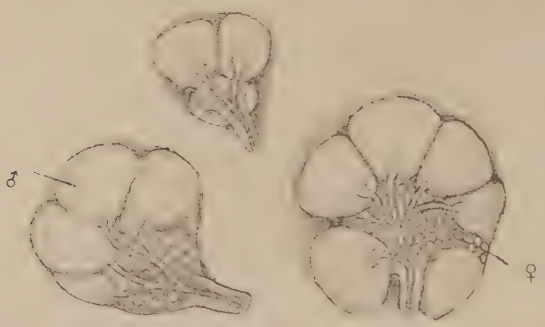


Fig. 61.—Ovaries of *Styela tuberosa*. More highly magnified.

to a considerable extent the spaces between the former. The latter bodies are most frequently pedunculate, and are sometimes as large as the reproductive masses, from which they chiefly differ in colour, being pale, somewhat pellucid, and almost homogeneous in structure. They do not seem to have any high functional import, their office apparently being to form, along with the generative bodies, a sort of pad or level surface for the support of the branchial sac, which otherwise might suffer from the inequality produced by the genitalia. These peculiar outgrowths are found in all the *Cynthiadæ* which have been examined.

The reproductive organs are similar to the above in *S. mamillaris* and in some other species.

Several interesting modifications of these organs are found in various species. In *S. variabilis* the ovaries assume the form of distinct, wide, slightly undulated tubes, of which there are two on the right and two on the left side of the mantle, each having its own short, nipple-like oviduct which opens into the cloaca, there being two on either side of the anus. The testis is composed of numerous, irregularly-lobulated vesicles scattered over the lower portion of the mantle on both sides, in the vicinity of the posterior extremities of the ovaries, but with which they have no connection, each separate vesicle having its own short, papillose vas deferens.

In the interstices amidst the reproductive nodules are numerous, soft, pallial nodules which vary much in size and form; but are usually more or less rounded, and rarely so large as the former.

1. **Styela tuberosa** (Macgillivray).

(Pl. XXXIV, figs. 1–5; Pl. XXXV, fig. 1; Pl. XXXVI, figs. 1–7; Pl. XLVIII, fig. 9; and figs. 60 and 61 in text.)

Cynthia tuberosa Macgillivray Moll. Anim. Aberdeen [1843], p. 311; Forbes & Hanley Brit. Moll. I [1848], p. 37; Alder & Hancock in Trans. Tyneside Nat. Field Club, I [1848], p. 195; [Ansted & Latham Channel Isl. (1862), p. 219; Alder in Rep. Brit. Assoc. for 1866 (1867), p. 208; M. & G. O. Sars Christianiafjord. Fauna, pt. 2 (1870), p. 102].

Body irregularly conical or sub-tuberous, pale brown, with a tinge of red towards the apertures, broadly attached at the base by root-like prolongations of the test. *Apertures*, branchial terminal, tubular, and broadly conical, uniting in outline with the body; atrial situated on a prominent subquadrate tube, rather more than a third down the side; both apertures reddish, and streaked internally with rose-colour and white. *Test* (Pl. XXXIV, figs. 1 and 5) thick, tough,

opaque, rather soft and contractile, strongly wrinkled, especially longitudinally, more or less mamillated, and much corrugated in contraction; generally covered with zoophytes and other extraneous matters; inside smooth and shining. *Mantle* (Pl. XXXIV, fig. 3; Pl. XXXV, fig. 1) adhering closely to the test, opaque yellowish white, streaked with red towards the apertures. *Tentacular filaments* linear, long, and tapering. *Branchial sac* (Pl. XXXIV, fig. 4; Pl. XXXVI, figs. 1 and 2) with four strong folds on each side; oral lamina smooth, narrow. *Ovaries* (Pl. XXXVI, figs. 2–7, and figs. 60 and 61 in text) thickly covering the internal surface of the mantle in rounded or ovate masses of a purplish or reddish hue, interspersed with soft pyriform papillæ.

Length two to two and a half inches; *breadth* one half less.

Hab.—On stones and shells in deepish water.

England. — Not uncommon on the coasts of Northumberland and Durham (*Alder*). [Cullercoats, Northumb. (*Alder & Hancock*, 1848).]

Scotland.—Aberdeen (*Macgillivray*).

Channel Islands.—Guernsey (*Alder*).

First record.—[Macgillivray, 1843.]

Styela tuberosa is a very coarse species, often much overgrown with zoophytes, and its form obscured by numerous swellings caused by *Modioli* imbedded in the test.

2. **Styela informis** (Forbes).

(Pl. XXXIV, fig. 6; Pl. XXXVI, figs. 8 and 9; and fig. 62 in text.)

Cynthia informis Forbes in Brit. Moll. I [1848], p. 38; [? Alder in Rep. Brit. Assoc. for 1866 (1867), p. 208].

"*Body* rudely conical, subtuberous; *test* (Pl. XXXIV, fig. 6) thick, coriaceous, crimson [or orange-coloured],

covered with rather undefined, large oblong warts; orifices on conical obtuse projections, four-lobed, deep crimson.

"*Length* two inches."

Hab.—From a depth of seven to nine fathoms (*Forbes*).

Scotland.—Stromness Bay, Orkney Islands; and Shetland; dredged (*Forbes & Goodsir*).

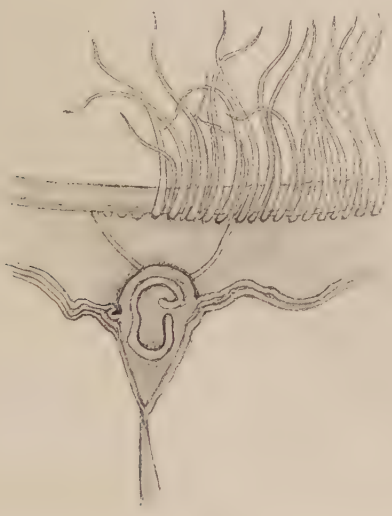


Fig. 62.—Tentacular filaments and branchial tubercle of *Styela informis*. Much enlarged.

First record.—Forbes & Hanley, 1848; *coll.* Forbes & Goodsir, 1839.

[On Plate XXXVI, fig. 8 represents the branchial sac and fig. 9 the digestive and reproductive organs.]

There may be some doubt whether this species is not a variety of the last.

3. **Styela quadrangularis** (Forbes).

Cynthia quadrangularis Forbes in Brit. Moll. I [1848], p. 38, pl. D, f. 1.

"*Body* conical; test thick, coriaceous, dark reddish-brown, warty; orifices rather large, on produced conical quadrangular eminences, the angles formed by strong ribs composed of united warts; rims of orifices white, with a fine crimson bordering line.

"*Length* nearly two inches."

Hab.—From a depth of thirty fathoms (*Forbes*).

Scotland.—Loch Fyne, Argyll; dredged (*Forbes & McAndrew*). Wick, Caithness (*Peach*).

First record.—Forbes & Hanley, 1848; *coll.* Forbes & McAndrew, 1845.

A specimen of this species is in Professor Goodsir's collection. The orifices are very wide and distinctly quadrangular, and the quadrate form of the tubes on which they are placed is continued on the body.

[The descriptions of this and the previous species are from Forbes & Hanley's 'British Mollusca.']

4. **Styela mamillaris** (Gaertner).

(Pl. XXXIV, figs. 7 and 8; Pl. XXXV, fig. 2; Pl. XLI, figs. 1–3.)

Distomus mamillaris Gaertner in Pallas' Spec. Zool. I, fasc. 10 [1774], p. 24.

Ascidia mamillaris Pallas Spec. Zool. I, fasc. 10 [1774], p. 24, [pl. i, f. 15;] Bruguière Hist. Nat. Vers, I [1789], p. 145, in Encycl. Méth.; [Bory de St. Vincent Vers, etc. I (1791), p. 135,] pl. lxii, f. 1, [in Tabl. Encycl. Méth.; Gmelin Linnæi Syst. Nat. ed 13 (1791), p. 3127; Bosc Hist. Nat. Vers, I (1802), p. 102; Turton Gen. Syst. Nat. IV (1802), p. 96, and Brit. Fauna, I (1807), p. 132; Duvernoy in Dict. Sci. nat. III (1816), p. 194; Lamarck Hist. Nat. Anim. sans Vert. ed. 1, III (1816), p. 123; Stewart Elem. Nat. Hist. I (1817), p. 392; MacLeay Horæ Entomol. pt. 2 (1821), p. 204; Stark Elem. Nat. Hist. II (1828), p. 117; Lamarck Hist. Nat. Anim. sans Vert. ed. 2 (1840), p. 527; Thompson in Ann. Nat. Hist. (1) V (1840), p. 94, and Nat. Hist. Ireland, IV (1856), p. 360].

Cynthia mamillaris [Schmidt in Ann. Chemie, LIV (1845), p. 318, and (transl.) in Taylor's Scient. Mem. V (1852), p.

34;] Forbes & Hanley Brit. Moll. [1848], p. 40; Alder in Ann. Nat. Hist. (3) XI [1863], p. 162.

[*Phallusia mamillaris* Lœwig and Kolliker in Neue Not. Geb. der Naturk. XL (1846), cols. 81, 98; Rupert Jones in Cyclop. Anat. IV, pt. 40 (1850), p. 1194, etc.; Schacht in Arch. f. Anat. 1851, p. 178, pl. iv, pl. v, ff. 1–6, and (transl.) in Q. J. Micr. Sci. I (1853), pp. 35, 107; Krohn in Arch. f. Anat. 1852, p. 312; Bronn Thier-Reichs, III, 1 (1861) p. 115, etc., pl. xii, ff. 1, 2; Schultze in Arch. f. mikr. Anat. XII, 2 (1862), pp. 179, 183, pl. xvii, f. 3.]

Body irregular, depressed, transversely ovate, attached throughout for nearly its whole length, deeply wrinkled and strongly lobed or mamillated. *Apertures* not far apart, the branchial a little distant from the anterior end, the atrial about the middle of the upper surface; sessile, slightly tubular when expanded but scarcely visible when contracted; their inner margins rayed with crimson. *Test* (Pl. XXXIV, fig. 7) very tough and thick, of a dirty yellowish colour, inside silvery and marked with red near the apertures, closely adherent to the mantle. *Mantle* (Pl. XXXIV, fig. 8 and Pl. XXXV, fig. 2) opaque, yellowish white or flesh-coloured, blotched with crimson towards the apertures. *Tentacular filaments* linear, long, and stout. *Branchial sac* (Pl. XLI, figs. 1 and 2) with four folds on each side; oral lamina smooth. *Ovaries* (Pl. XLI, figs. 2 and 3) scattered.

Length an inch and a half to two inches.

Hab.—On submarine rocks (*Gaertner*). [Attached to *Laminaria digitata* (*Thompson*).]

England.—Hastings, Sussex (*Bowerbank*). Lulworth Cove, Dorset (*Jeffreys*). Cornish coast (*Gaertner*). Plymouth, Cornwall (*Bate*).

Ireland.—[Strangford Lough, Down, and Belfast Lough, Antrim (*Thompson*, 1840)].

Channel Islands.—Guernsey (*Norman*).

First record.—Gaertner, in Pallas [1774].

Of this curious species, which had not hitherto been recognized since the time of Gaertner and Pallas, I had

a few specimens sent to me from Plymouth by Mr. Spence Bate, and more recently several others from Lulworth Cove, Dorsetshire, by Mr. Gwyn Jeffreys. In its contracted state *C. mamillaris* is a very uncouth-looking mass, and would scarcely be recognized as an animal except by the practised eye of a naturalist; in that state the apertures being generally concealed by the prominent lobes of the test, and the surface much covered with small zoophytes and algæ. It was from this latter circumstance no doubt that Pallas described it as irregularly clothed with soft hairs. *Modiola marmorata* is frequently found imbedded in the test, and fragments of shells and stones often adhere to the root-like prolongations of the base, and occasionally also to the surface of the test.

May not this be the species alluded to by Forbes under the name of *Cynthia microcosmus*, as occurring on the south coast of England?

5. **Styela opalina** (Alder).

(Fig. 63 in text.)

Cynthia opalina Alder in Ann. Nat. Hist. (3), XI [1863], p. 164.

Body transversely ovate, strongly but irregularly mamillated, opaline white, attached by a broad base. *Apertures* not far apart, rather large, the branchial placed not far from the anterior end. *Test* (fig. 63) thick, smooth, white, semi-transparent, adhering strongly to the mantle throughout. *Mantle* opaque white, with one or two blotches of red near the apertures. *Tentacular filaments* linear (?). *Branchial sac* with four folds on each side (?), oral lamina smooth, inconspicuous.

Breadth about three-quarters of an inch; *height* one-third less, rising a little towards the anterior end.*

* Alder in 'Ann. Nat. Hist.' (3), XI, p. 164. [The "breadth" of the "large specimen" figured by Mr. Hancock (fig. 63) was less than half an inch, the "height" one-third of an inch.]

Hab.—From ten to fifteen fathoms depth.

England. — Diamond trawling ground, Hastings, Sussex (*Bowerbank*).

First record.—Alder [1863]; *coll.* Bowerbank.

Of this pretty little species a single specimen only was obtained, and, as the internal parts were partially decomposed, their character could not be very satisfactorily made out. We know of no other *Styela*, however, with which it can be confounded. In its opaline and mamillated test it somewhat resembles a miniature *Ascidia mamillata*, but besides its generic difference, it

Fig. 63.—Test of *Styela opalina*. Two and a half times natural size. *br.* Branchial aperture.

likewise differs in form, and in the more numerous and smaller mamillæ.

6. **Styela coriacea** Alder & Hancock.

(Pl. XXXVII, figs. 1–4; Pl. XXXIX, figs. 2 and 3; Pl. XLI, figs. 4 and 5.)

Cynthia coriacea Alder & Hancock in Trans. Tyneside Nat. Field Club, I [1848], p. 196; Forbes & Hanley Brit. Moll. II [1849], p. 375; [Cocks in Rep. R. Cornw. Polyt. Soc. 1849 (1850), p. 72; Alder in Nat. Hist. Trans. Northumb. Durham, I (1865), p. 11; Norman in Rep. Brit. Assoc. for 1868 (1869), p. 303].

Body conical or cylindrical when extended, nearly hemispherical when contracted, adhering by a broad base. *Apertures* terminal, approximated, slightly tubular, each edged with a line of red. *Test* (Pl. XXXVII, figs. 1–4) yellowish-brown, minutely granular, rough, much wrinkled, and often covered with zoophytes

when old; smooth and silvery on the inner surface. *Mantle* (Pl. XXXIX, figs. 2 and 3) thin, white, slightly sprinkled with brown. *Tentacular filaments* linear, stout, blotched with brown. *Branchial sac* (Pl. XLI, fig. 4) with four folds on each side. *Ovaries* (Pl. XLI, fig. 5) large and white, lining the mantle with transverse cylindrical convolutions.

Height upwards of an inch when extended; *breadth* half to three quarters of an inch.

Hab.—Deep water, usually on shells.

England.—Cullercoats, Northumb.; brought in on the fishermen's lines (*Alder* [1848]). [Dogger Bank (*Alder*, 1865). Falmouth, Cornwall (*Cocks*, 1849).]

Scotland.—Shetland (*Jeffreys*). [Dourie Voe, Shetland, 1863 (*Norman*, 1868).]

First record.—Alder & Hancock, 1848; *coll.* Alder.

Styela coriacea is a very contractile species, and in its two states of extension and contraction might be taken for different animals. The close-set, minute tubercles of its surface distinguish it from most of its congeners. These are rounded and not shagreened or facetted as in *S. granulata*, and they can scarcely be seen without a magnifier. Young specimens consequently appear to be smooth, and are almost flat when contracted. Old individuals, however, become much more rugose.

7. **Styela pomaria** (Savigny).

(Pl. XXXVII, fig. 5; Pl. XXXIX, fig. 4; Pl. XLII, figs. 1–7; Pl. XLVIII, fig. 10; and fig. 64 in text.)

Cynthia pomaria Savigny [in Descr. Égypt., Hist. Nat. I (1809), pt. 3, p. 39, and] Mém. Anim. sans Vert. pt. 2 [1816], p. 156, pl. ii, f. 1, and pl. vii, f. 2; Lamarck Hist. Nat. Anim. sans Vert. ed. 2 [1840], p. 531; [Rupert Jones in Cyclop. Anat. IV, pt. 40 (1850), p. 1199; Bronn Thier-Reichs, III, 1 (1861), p. 104, etc., pl. xii, ff. 5, 6; Grube in Abh. Schles. vaterl.-Cultur, 1868–69 (1869), pp. 112, 125].

Body ovate or subconical, rather irregular, rugose, largely attached by the side or base. *Apertures* not far apart, rather prominent. *Test* brownish or yellowish, sub-opaque, strongly wrinkled longitudinally and less prominently in a transverse direction so as to give it a pustulose appearance; the surface slightly roughened, but not hispid. *Mantle* opaque, bright crimson above, fading into orange or yellow below. *Tentacular filaments* slender. *Branchial sac* with four folds on each side; oral lamina smooth. *Ovaries* globose, red, dispersed over the inside of the mantle in imperfect longitudinal rows.

Length from half to three quarters of an inch.

Hab.—In shallowish water.

Wales.—Tenby, Pembroke (*Alder*).

Ireland.—Portmagee, Kerry (*Allman*).

Channel Islands.—Guernsey (*Hodge & Brady*). Gouliot Caves, Sark (*Norman*).

First record.—Alder & Hancock.

The test of this species (Pl. XXXVII, fig. 5) is hard, firm, and rather thick, with the inside silvery white.

The mantle (Pl. XXXIX, fig. 4) is thick, tough, and muscular, with the fibres inconspicuous on the surface; but, when the reproductive organs are removed, strong muscular fibres are seen to line the inside, arranged for the most part diagonally from the ventral line downwards and backwards. The tentacular filaments are numerous and vary in size; they are delicate, not long, and nearly linear.

The folds of the branchial sac (Pl. XLII, fig. 1) are moderately developed; the primary vessels are numerous, not much apart, variable in size with usually minute ones interspersed, crossing the stomata; the secondary vessels are rather stout and short, and the stomata are rounded at the ends. The oral lamina is smooth, narrow, and widened a little below. The branchial tubercle (Pl. XLVIII, fig. 10) is peculiar; it

is rounded and apparently open in the centre, with a bilobed lid; but, as this appearance varies in different specimens, it is probably deceptive.

The alimentary canal (Pl. XLII, fig. 2) forms a sigmoidal curve extending from the bottom of the pallial sac to the base of the excurrent orifice. The œsophagus is well developed and somewhat constricted; the stomach (Pl. XLII, fig. 2) is oval and well defined at both extremities, and the interior is lined with numerous deep, close-set, longitudinal laminæ; the intestine is rather wide and of pretty equal calibre throughout; the anus (fig. 64) is a little contracted

Fig. 64.

Fig. 65.

Fig. 64.—Anal aperture of *Styela pomaria*. Magnified. Fig. 65.—Anal aperture of *Styela granulata*. Magnified.

with the rim narrow and broken up into a few obtuse irregular denticulations.

The reproductive organs (Pl. XLII, figs. 2–7) are numerous rounded nodules scattered without much regularity over both lobes of the mantle; though there is occasionally the appearance of a longitudinal disposition. This appearance is heightened, if not entirely occasioned, by observing these organs through the branchial sac, those underlying the branchial folds being obscured and thus producing the appearance of separation into rows (Pl. XLII, fig. 1). The male vesicles form a sort of cup around the base of each ovigerous sac (Pl. XLII, figs. 3–7), composed of from four to seven segments, each segment being one of the vesicles; from the apices of the vesicles the minute thread-like ducts are seen to pass to the upper surface of the organ and go to unite at the base of a minute, extremely short, nipple-like, orifice, overlying the

almost equally short, projecting, comparatively-wide oviduct directed towards the ventral margin or atrial space. Thus there are as many oviducts and male outlets as genital nodules.

8. **Styela sulcatula** (Alder).

(Pl. XXXVII, figs. 6 and 7; Pl. XLII, figs. 8 and 9; Pl. XLVIII, fig. 11.)

Cynthia sulcatula Alder in Ann. Nat. Hist. (3) XI [1863], p. 162.

Body sub-cylindrical when extended, hemispherical when contracted, attached by a broad base. *Apertures* terminal, on long tubes (about one-third the length of the body), approximating at the base, and nearly disappearing on contraction; they are margined with a red line or entirely crimson. *Test* dark reddish-brown, rough with longitudinal and transverse furrows, giving the surface a beaded appearance. *Mantle* bright crimson or scarlet. *Tentacular filaments* linear. *Branchial sac* with four folds on each side. *Ovaries* scarlet, disposed in spherical masses over the inner surface of the mantle.

Length from half to three-quarters of an inch.

Hab.—From a few fathoms to deep water, on *Styela tuberosa* and the roots of *Laminaria*.

England.—Cullercoats, Northumb. (*Alder*). Seaham Harbour, Durham (*Hodge*).

First record.—Alder [1863].

The longitudinal sulcations of the test of this species (Pl. XXXVII, figs. 6 and 7) are scarcely perceptible in spirit specimens; but the upper portions are much contracted and consequently much wrinkled transversely; the inside is silvery white.

The mantle, which is opaque and fleshy, is firmly attached to the test. The tentacular filaments are about forty; they are short (varying in size), delicate, and nearly linear.

The branchial sac (Pl. XLII, fig. 8) is delicate and the folds are rather narrow; the primary vessels are stoutish, vary in size, and have an exceedingly delicate vessel between them, cutting the stomata in the centre; the secondary vessels are delicate and of moderate length; the ends of the stomata are rounded; the longitudinal rods are wide, there are one or two between the folds, and five or six upon them. The branchial tubercle (Pl. XLVIII, fig. 11) is rather peculiar in form; it is rounded in front with a small opening in the centre which is overhung by a pointed process, probably indicating a rudimentary condition of the spirals. The oral lamina is narrow, but slightly deepens towards the mouth.

The alimentary canal (Pl. XLII, fig. 9) forms a deep sigmoidal curve towards the inferior extremity of the body; the œsophagus is well developed; the stomach (Pl. XLII, fig. 9) is short and rounded, with the internal laminæ seen through the surface; the walls of the first or looped portion of the intestine are thick; but the tissue is more delicate, and the calibre diminishes a little towards the anus, which is not very wide, and has a narrow margin with a few minute denticulations. The biliary ducts are rather long, and the pyloric lobe which receives them is large and conical.

The reproductive organs (Pl. XLII, fig. 9) are numerous, rather large, oval or rounded nodules; the oviducts and male outlets are similarly arranged to those of the last species (*S. pomaria*); but the male vesicles do not appear to be confined to the sides and base; the ova however were not much developed in the individual examined, and the relative positions of the two elements might consequently be somewhat modified. Numerous pallial nodules, large and very irregular in form, are interspersed amidst the reproductive organs.

The approximate tubular apertures, regularly furrowed surface, and great contractility, distin-

guish this species from the young of *S. tuberosa*; the character of the surface distinguishes it from *S. coriacea* and *S. granulata*, to which it is more nearly allied. In a contracted state the test becomes much corrugated, and the apertures then appear large and four-cleft.

9. **Styela granulata** (Alder).

(Pl. XXXVII, figs. 8 and 9; Pl. XXXIX, figs. 5 and 6; Pl. XLII, figs. 10 and 11; Pl. XLVIII, fig. 12; and figs. 65 and 66 in text.)

Cynthia granulata Alder [MS. sp. in Ansted's Channel Isl. (1862), p. 219, and] in Ann. Nat. Hist. (3) XI [1863], p. 163; [M. & G. O. Sars Christianiafjord. Fauna, pt. 2 (1870), p. 103].

Body cylindrical when extended, nearly hemispherical when contracted, reddish, adhering at the base. *Apertures* terminal, approximated, slightly tubular, red with a darker red line round the margin. *Test* (Pl. XXXVII, figs. 8 and 9) tough, finely shagreened or granulated, but appearing nearly smooth to the naked eye, yellowish or brownish red. *Mantle* (Pl. XXXIX, figs. 5 and 6) crimson above, passing to orange or yellow below. *Tentacular filaments* linear. *Branchial sac* (Pl. XLII, fig. 10) with four folds on each side.

Length about half an inch.

Hab.—Adhering to shells or to other Ascidians, in moderately deep water.

England.—Cullercoats, Northumb. (*Alder*). Seaham Harbour (*Hodge*) and Whitburn (*Alder*), Durham. Lulworth Cove, Dorset (*Jeffreys*). Isle of Man (*Alder*).

Channel Islands.—Guernsey (*Alder*).

First record.—[Ansted, 1862; *coll.* Alder.]

This *Styela* somewhat resembles the last (*S. sulcata*), and is occasionally associated with it on the test of *S. tuberosa*. It may, however, be at once distinguished

by the shagreening of the test, which is best seen when the surface is dry; it then appears covered with minute shining facets. *S. granulata* may also be distinguished from *S. sulcata* by its shorter tubes and smaller apertures. It appears to be pretty-widely distributed on the British coast.

Fig. 66.—Digestive organs (on left) and reproductive organs (on right) of *Styela granulata*. Magnified. *b.d.* Biliary duct.

10. **Styela humilis** *sp. nov.*

(Pl. XXXIX, fig. 7; Pl. XLVIII, fig. 13.)

[*Cynthia humilis* Alder MS. sp. in Ansted's Channel Isl. (1862), p. 219.]

Body elongate, conical, closely covered with fine sand and a few fragments of shells; adhering by a small base. *Apertures* wide apart, the branchial produced and terminal, the atrial conical, about three quarters down the body or not far from the base. *Test* rather thin, set with short hairs or membranous processes of the skin, to which the sand adheres. *Tentacular filaments* linear. *Branchial sac* with four

shallow folds on each side, the meshes elliptical, in rather distant rows.

Length nearly an inch.

Hab.—Adhering to nullipores.

Channel Islands.—St. Peter's Port, Guernsey; dredged (*Alder*).

First record.—[Ansted, 1862; *coll.* Alder.]

The test of *S. humilis* (Pl. XXXIX, fig. 7) is coriaceous with a metallic lustre inside. The mantle is thin and firmly attached to the test.

The branchial folds are much narrower than usual; the primary vessels, which are rather large, are regularly disposed, and have a minute vessel between them which crosses the stomata. The stomata are fusiform with the extremities pointed; they do not reach from vessel to vessel, and their rows are consequently further apart than is usual; there are widish spaces bordering the primary vessels. The longitudinal rods are wide, with the thickened free margin stout; there are four or five on the folds, and three or four between them. The oral lamina is smooth and moderately developed; the branchial tubercle (Pl. XLVIII, fig. 13) is small.

The alimentary canal is short and looped; the stomach is rounded and its interior is laminated.

The reproductive organs are composed of numerous oval or rounded nodules.

This species has considerable resemblance to *Styela comata* in most of its characters, but is at once distinguished from it by the position of the apertures, which in *S. humilis* are more widely apart than in any other species of the genus, while in *S. comata* they are close together at the upper end. *S. humilis* also is attached.

11. **Styela variabilis** *sp. nov.*

(Pl. XXXVII, figs. 10–12; Pl. XLIII, fig. 1; Pl. XLVIII, fig. 14.)

Body variable in form, ovate, sub-orbicular, or subconical, and strongly wrinkled in opposite directions

so as to give the surface a tuberculated appearance; largely attached by the side. *Apertures* approximated; nearly terminal, generally margined with a line of crimson or orange. *Test* (Pl. XXXVII, figs. 10 and 11) rather thick, firm, yellowish white or brownish, covered with roundish tubercles, the inside bright crimson. *Mantle* (Pl. XXXVII, fig. 13) crimson above, fading to pale red or orange below. *Tentacles* long and slender; the branchial aperture above them crimson, and for some extent longitudinally plicated, the lobes forming an operculum below. *Branchial sac* white; oral lamina smooth. *Ovaries* (Pl. XLIII, fig. 1) orange-coloured, forming two diagonal rolls on each side, bordered by lobed or clavate spermaries.

Length from half an inch to upwards of an inch.

Hab.—In shallow water and under stones within tide-marks.

Channel Islands.—Guernsey and Herm; not rare (*Alder; Brady & Hodge; Norman*).

First record.—Alder & Hancock.

This species varies much in form. Its usual appearance is something like a raspberry, but old specimens are sometimes found a good deal elongated and very rugose. It is largely attached, the margin of the test spreading a little in a thin crust on the stone or other substance to which it adheres.

The reproductive organs are rather peculiar, the ovaries forming two cylindrical rolls, running diagonally on each side of the body, and at the sides of these are seen detached groups of obtusely-lobed or slightly-branched male organs.

Styela variabilis has only as yet been found in the Channel Islands.

Fig. 67.—Tentacular filaments of *Styela obscura*. Magnified.

12. **Styela obscura** *sp. nov.*

(Pl. XXXVII, fig. 13 (?) *; Pl. XLVIII, fig. 15; and figs. 67–69 in text.)

Body sub-cylindrical or sub-conical, attached by the base, and coated with a thin but close envelope of fine sand. *Apertures* tubular and prominent, coated with sand the same as the body; the branchial terminal, rather broad, quadrate, and wide, margined with red; the atrial about one third down, on a strong tube, rather narrower than the other, and rising upwards. *Test* (Pl. XXXVII, fig. 13) nearly colourless, without filaments, the sand adhering closely to the surface. *Reproductive organs* scattered over the inner surface of the mantle.

Length about three-quarters of an inch.

Hab.—?

Channel Islands.—Guernsey; dredged (*Jeffreys & Norman*).

First record.—Alder & Hancock; *coll.* Jeffreys & Norman, 1865.

Fig. 68.

Fig. 69.

Fig. 68.—Digestive organs of *Styela obscura*. Magnified. Fig. 69.—Anal aperture of the same. More highly magnified. *b.d.* Biliary duct.

This species has some resemblance to *Styela humilis*, but differs from it in the position of the atrial aperture, as well as in the filaments. From *S. comata* it differs in the latter character, also in being attached, and in

[* There may be some doubt as to this figure representing *Styela obscura*. It agrees with the description except in colour, perhaps due to sand.]

the tubes being coated with sand like the rest of the body, and very partially retractile.

13. **Styela comata** (Alder).

(Pl. XXXVII, fig. 14; Pl. XXXIX, fig. 8; Pl. XLIII, figs. 2 and 3; Pl. XLVIII, fig. 16; and figs. 70 and 71 in text.)

Cynthia ampulla Forbes & Hanley Brit. Moll. I [1848], p. 40; Alder & Hancock in Trans. Tyneside Nat. Field Club, I [1848], p. 197; [Owen in Encycl. Brit. ed. 8, XV (1858), p. 331].
Non *Ascidia ampulla* Bruguière [Hist. Nat. Vers, I (1789)].
Cynthia comata Alder in Ann. Nat. Hist. (3) XI [1863], p. 163, [and in Nat. Hist. Trans. Northumb. Durh. I (1865), pp. 6, 11].

Body unattached, oblong ovate, flask-shaped. *Apertures* terminal and approximated, forming elongated tubes of nearly equal length, generally prettily blotched and spotted with red, and retractile. *Test* (Pl. XXXVII, fig. 14) very thin, soft, transparent, and nearly colourless, set with long tufted hairs and covered with a thick coating of sand. *Tentacular filaments* linear, simple. *Branchial sac* (Pl. XLIII, fig. 2) with four folds on each side. *Ovaries* (Pl. XLIII, fig. 3, and fig. 71 in text) extending over nearly all the internal surface of the mantle in small ovate or pyriform masses.

Length a little above an inch.

Hab.—Deep water.

England.—Cullercoats, Northumb.; from the fishing boats, not uncommon (*Alder*). [Durham (*Alder*, 1865).]

First record.—Forbes & Hanley, 1848; [*coll.* Alder].

Styela comata is remarkable for the thick coating of sand with which it is always invested, sometimes increasing it to double the natural size. This arises from the great length of the glandular hairs, and is especially the case in old individuals, in which they are much branched and become thickened at the base,

giving the test a peculiar appearance when the sand is removed.

This species was at first referred to the *Ascidia ampulla* of Bruguière, the *Ascidium* of Baster; but a more attentive study of its characters, and a reference

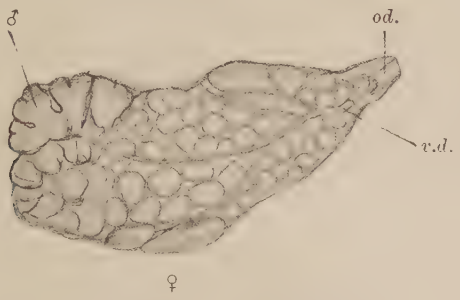


Fig. 70.—An ovary of *Styela comata*. Magnified. *od.* Oviduct. *v.d.* Vas deferens.

to the original description and figures of Baster, induce us to consider it distinct. His *Ascidium* is described as thickly covered with minute hairs curved at the points, and as having the tubes granulated or shagreened, in neither of which characters does the present species

Fig. 71. Fig. 72.

Fig. 71.—Anal aperture of *Styela comata*. Magnified. Fig. 72.—Anal aperture of *Styela vestita*. Magnified.

agree with it, nor does Baster's species appear to have been coated with sand.

This and the following species belong to the *Glandula* of Stimpson,* a genus divided from *Cynthia* on account

* 'Proc. Boston Soc. Nat. Hist.' [IV (1852), p. 230].

of the individuals being unattached. As this character, however, is not borne out by any structural difference, and is also found in some species of other genera, we have not thought it desirable to consider it of generic value.

14. **Styela vestita** (Alder).

(Pl. XXXVII, fig. 15; Pl. XXXIX, fig. 9; Pl. XLIII, figs. 4 and 5; Pl. XLVIII, fig. 17; and figs. 72–76 in text.)

Cynthia vestita (Alder) Stanger in Trans. Tyneside Nat. Field Club, IV [1860], p. 335; [Alder in Nat. Hist. Trans. Northumb. Durh. I (1865), pp. 6, 11].
Cynthia glacialis Alder in Ann. Nat. Hist. (3) XI [1863], p. 164.

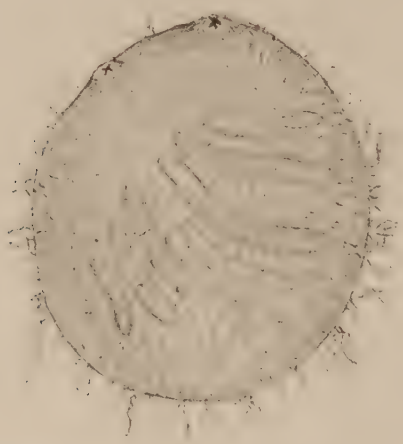


Fig. 73.—Test of *Styela vestita*, devoid of shell fragments, and with the apertures retracted. Four times natural size.

Body orbicular or ovate, a little compressed, unattached, and [almost] entirely covered with sand and fragments of shells. *Apertures* approximated and slightly tubular when expanded, inconspicuous when withdrawn, of a dull semitransparent white. *Test* (Pl. XXXVII, fig. 15, and fig. 73 in text) smooth,

whitish, soft and rather thin, a little wrinkled towards the apertures, with scattered hairs, and shelly fragments adhering partially to the skin. *Mantle* (Pl. XXXIX, fig. 9) transparent and nearly colourless. *Tentacular filaments* (fig. 72) simple, linear. *Branchial sac* (Pl. XLIII, fig. 4) with four folds on each side. *Ovaries* (Pl. XLIII, fig. 5) in parallel cylindrical masses, extending transversely, about four on each side.

Fig. 74.—Tentacular filaments of *Styela vestita*. Magnified.

Diameter about half an inch.
Hab.—Deep water.

England.—Craster, Northumb.; from the fishing-boats (*Stanger*). Dredged on the coasts of Northumberland and Durham in the excursions of the local Dredging Committee of the British Association [1862–64].
First record.—Stanger, 1860.

Mr. Stanger, who first met with this species, announced its discovery in the 'Transactions of the Tyneside Naturalists' Field Club,' under the above specific name which we had proposed for it. We afterwards thought it might be the same as a species found by Professor Sars on the Norwegian coast, and, in a paper in the 'Annals of Natural History,' we adopted his name of *Cynthia glacialis*. A more detailed description, however, since published by Professor Sars, shows that his species is quite distinct, and belongs to

our restricted genus *Cynthia*. We have therefore reverted to our original name.

The form and position of the reproductive organs is very peculiar in this Tunicate. The only other

Fig. 75.

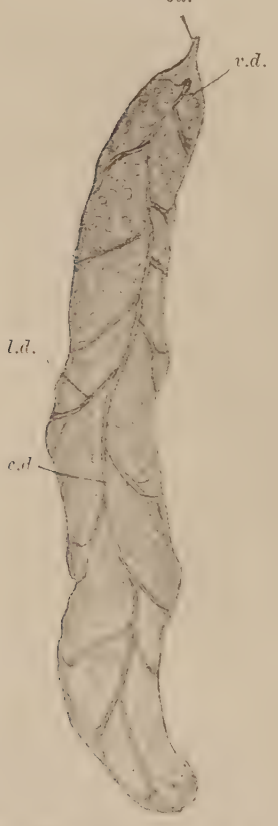


Fig. 76.

Figs. 75 and 76.—Ovary of *Styela vestita*. Highly magnified. 75, front view; 76, side view of another.

species in which we have met with the same arrangement of these organs is the *Glandula mollis* of Stimpson, a free and sand-covered species found on the American coasts and apparently very near to this in most of its characters.

15. **Styela violacea** (Alder).

(Pl. XXXVII, figs. 16 and 17; Pl. XXXIX, figs. 10–12.)

Cynthia violacea Alder in Ann. Nat. Hist. (3) XI [1863], p. 165, [and in Rep. Brit. Assoc. for 1866 (1867), p. 208].

Body very much depressed or nearly flat, transversely ovate or rounded in outline, and adhering by a broad expanded base. *Test* slightly hispid and completely covered with small grains of sand. *Apertures* on rather long and slender tubes of a violet colour, set very little apart, and nearly equally distant from both ends.

Diameter a quarter of an inch.

Hab.—Amongst rocks, on an old shell of *Pecten maximus*.

Wales.—Anglesey, in Menai Straits (*Mrs. Hughes*).

First record.—Alder [1863]; *coll.* Mrs. Hughes.

Although, from its minuteness and delicacy, the internal parts of this species could not be examined, there can be little doubt of its distinctness from any other described *Styela*. The grains of sand adhere so closely that they can scarcely be removed without tearing the test, which is very thin. Two specimens were found.

16. **Styela fibrillata** *sp. nov.*

(Pl. XXXVII, fig. 18; Pl. XXXVIII; Pl. XL, fig. 9; Pl. XLIV, figs. 1–3; and figs. 77 and 78 in text.)

Body suborbicular or ovate, covered with long, slender, or tufted fibrils, occasionally anastomosing, and coated with fine sand, free or very slightly attached. *Test* (Pl. XXXVII, fig. 18; Pl. XXXVIII, fig. 1; Pl. XXXIX, figs. 13 and 14) rather tough, shining inside. *Apertures* not far apart. *Mantle* yellowish, inclining to orange, but probably more or

less red when fresh. *Tentacular filaments* long and slender. *Branchial sac* with stout transverse vessels and rather narrow folds. *Reproductive organs* scattered (?).

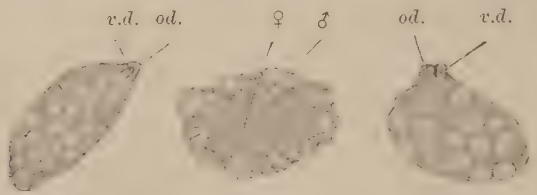


Fig. 77.—Ovaries of *Styela fibrillata*. Highly magnified.

Diameter half to three quarters of an inch.
Hab.—?

England.—Hastings, Sussex (*Bowerbank*).
Ireland.—Birterbuy Bay, Connemara, Galway (*Brady*).
Channel Islands.—Guernsey (*Norman*).
First record.—Alder & Hancock.

Fig. 78.

Fig. 79.

Fig. 78.—Anal aperture of *Styela fibrillata*. Magnified. Fig. 79.—Anal aperture of *Styela northumbrica*. Magnified.

17. **Styela depressa** *sp. nov.*

(Pl. XXXIX, figs. 13–16; Pl. XLIV, figs. 4 and 5.)

Body transversely ovate, rather depressed, attached by a broad base. *Apertures* approximated. *Test* (Pl. XXXIX, figs. 13 and 14) hispid; the upper portion covered with sand; the lower or attached portion free from sand, thin and with a few scattered fibrils. *Mantle* [as represented by figs. 15 and 16 of

Plate XXXIX]. *Branchial sac* (Pl. XLIV, fig. 4) with pretty-stout longitudinal folds, the transverse vessels slender; oral lamina smooth. *Reproductive organs* (Pl. XLIV, fig. 5) scattered.

[Longest diameter about half an inch.]

Hab.—?

Channel Islands.—Guernsey; dredged (*Norman*).

First record.—Alder & Hancock; *coll.* Norman.

Two specimens were obtained; one attached to the inside of an old shell of *Pectunculus glycimerus*, the other on the carapace of a crab (*Maia squinado*).

This species differs from the last principally in the depressed form, the larger surface of attachment, and the shorter fibrils.

18. **Styela northumbrica** *sp. nov.*

(Pl. XXXIX, fig. 17; Pl. XLIV, fig. 6; and figs. 79 and 80 in text.)

Fig. 80.—Reproductive organs of *Styela northumbrica*. Magnified.

Body cylindrical, only slightly contractile, adhering by a narrow base, but with the test sometimes considerably extended in an encrusting form. *Apertures* terminal, approximated, red. *Test* (Pl. XXXIX, fig. 17) rather thick, firm, dull red or reddish-brown, covered

with small rounded tubercles, inside bright crimson. *Mantle* opaque, cream-coloured. *Tentacular filaments* long, slender, linear. The interior of the branchial aperture crimson, and for some distance longitudinally plicated, the lobes forming an operculum below. *Branchial sac* white, with four folds on each side. *Ovaries* (Pl. XLIV, fig. 6 and fig. 81 in text) orange-coloured, forming a cluster on each side.

Length half an inch.

Hab.—Deep water, on *Modiola vulgaris*.

England.—Northumberland.

First record.—Alder & Hancock.

[Genus 8. **STYELOPSIS** Traustedt, 1882.]

[*Ascidia* (pars) O. F. Müller Zool. Danica, I (1788), p. 14.
Phallusia (pars) Fleming Brit. Anim. (1828), p. 469.
Cynthia (pars) Forbes & Hanley Brit. Moll. I (1848), p. 39.
Styelopsis Traustedt in Vid. Medd. Kjobenh. (1882), p. 115.]

[*Body* globular or cylindrical, attached at the base. *Apertures* terminal or nearly so, four-cleft. *Test* tough, usually wrinkled or rugose, rarely smooth. *Mantle* closely adherent to the test, more or less crimson in colour. *Tentacular filaments* simple. *Branchial sac* with a single strong fold near the ventral edge on the left side, and a few rudimentary folds, one of which may sometimes be clearly seen; and occasionally with one or two very indistinct folds on the right side. *Ovaries* on the left side only; usually tubular, rarely globular.

The authors recognized that Van Beneden's *Ascidia grossularia* ought to form the type of a new genus which they neither named nor described, but for which a space is left in the transcript of their MS. They also referred to their proposed new genus, Alder's *Cynthia glomerata* and two new species. Their opinion that these species should form a new genus must have been arrived at between the years 1863 and 1867, the

earlier that on which Alder published *Cynthia glomerata*, the later that of his death. They do not give any reason for suggesting the removal of the species from *Cynthia* or *Styela*, merely leaving a blank space for a new generic name.

It was not until 1882 that a similar view was first published, Traustedt in that year founding the genus *Styelopsis* for the single species *Ascidia grossularia* Van Ben., which in 1848 Forbes and Hanley had removed to the genus *Cynthia*. Its affinities are more with *Styela* than with *Cynthia*, and Traustedt distinguished it from *Styela* by the presence of only one plait in the branchial sac, which he says is on the right side; the genital organs also only being developed on the right side. His right side, it should be understood, is Alder and Hancock's left side.

Traustedt's definition of these genera, in 'Vidensk. Medd. Kjobenhaven,' 1882 (vol. dated 1883), p. 115, may be thus translated:—

Styela.—Branchial sac with four folds on the left side (right, A. & H.); genital organs developed on both sides.

Styelopsis.—Branchial sac with only one fold, on the right side (left, A. & H.); genital organs only developed on the right side (left, A. & H.).

The Editor has deemed a departure from his rule not to include any observation of later date than 1870 to be unavoidable with this genus.]

1. **[Styelopsis] grossularia** (Van Beneden) Traustedt.

(Plate XLVI, figs. 1–4.)

Ascidia rustica jun. O. F. Müller Zool. Danica, I [1788], p. 14 (*pars*), pl. xv, ff. 1, 2.

[*Ascidia rustica* Jameson in Mem. Wernerian Soc. I (1811), p. 556; Pennant Brit. Zool. ed. 5, IV (1812), p. 100; (Anon.) Encycl. Perth. ed. 2 (1816), p. 597, pl. xiii, f. 9; Thompson in Ann. Nat. Hist. (1) V (1840), p. 94; (?) Johnston Introd. Conch. (1850), p. 297.]

[*Phallusia rustica* Fleming Brit. Anim. (1828), p. 469.]
Ascidia grossularia Van Beneden Rech. Ascidies simpl. [in Mém. Acad. Roy. Belg. XX (1847), p. 61, pl. iv, ff. 6–11; Thompson in Ann. Nat. Hist. (2) I (1848), p. 63; Forbes in Rep. Brit. Assoc. for 1850 (1851), p. 253; Rymer Jones Organiz. Anim. Kingd. ed. 2 (1855), p. 494; ed. 3 (1861), p. 487; and ed. 4 (1871), p. 523; Thompson Nat. Hist. Ireland, IV (1856), p. 360].
Cynthia rustica Forbes & Hanley Brit. Moll. I [1848], p. 39; Alder & Hancock in Trans. Tyneside Nat. Field Club, I [1848], p. 197; [Landsborough Treas. Deep (1847), p. 49, and Excurs. Arran (1852), p. 49; Norman in Zoologist, XV (1857), p. 5708; Dickie in Rep. Brit. Assoc. for 1857 (1858), p. 111].
Cynthia grossularia [Forbes & Hanley Brit. Moll. I (1848), p. 40; Cocks in Rep. R. Cornw. Polyt. Soc. 1849 (1850), p. 72; Gosse Tenby (1856), p. 93; Bronn Thier-Reichs, III, 1 (1861), p. 161; Ansted Channel Islands (1862), p. 219;] Alder in Ann. Nat. Hist. (3) XI [1863], p. 165; [in Nat. Hist. Trans. Northumb. Durh. I (1865), p. 11; and in Rep. Brit. Assoc. for 1866 (1867), p. 208; McIntosh in Proc. Roy. Soc. Edinb. (1866), p. 605; Norman in Rep. Brit. Assoc. for 1868 (1869), p. 303; M. & G. O. Sars Christianiafjord. Fauna, pt. 2 (1870), p. 102].
[*Styelopsis grossularia* Traustedt in Vid. Medd. Kjobenh. (1882), p. 115.]

Body hemispherical, more or less rugose, rusty red, bright red, or yellowish drab, largely adherent and spreading at the base when single, more erect when in compact clusters. *Apertures* rather large, shortly tubular, bright red, set considerably apart on the upper surface. *Test* tough, thickish, and much wrinkled in old specimens, nearly smooth when young. *Mantle* crimson, yellowish at the base. *Tentacular filaments* large and stout. *Branchiæ* orange-coloured, with a single strong fold near the ventral line on the left side, occasionally a small accessory one on the same side, and one or two very indistinct folds on the right; oral lamina broad and smooth. *Ovaries* large, cylindrical, arranged in a longitudinal line [on the left side].

Diameter from a quarter to half an inch.

Hab.—Between tide-marks and in shallow water, on the underside of stones; on the roots and stems of *Laminaria*, and occasionally on the fronds of fuci; common on oysters. [Adhering to the roots of *Laminaria* (*Fucus*) *digitata* (*Jameson*). Commonly investing the larger marine plants, and on shells, stones, etc. (*Thompson*).]

Common on all our coasts.

First record.—Forbes and Hanley, 1848. [Jameson, as *Ascidia rustica*, 1811.]

[*Styelopsis*] *grossularia* (Pl. XLVI, figs. 1–4) is an extremely variable species, changing its appearance so much in different situations and under different circumstances that we have sometimes been induced to think that more than one species might be included in it. When growing singly it is rather depressed, and the test spreads into a thin membrane around the base (Pl. XLVI, figs. 3 and 4), but in sheltered situations, as under shelving rocks, the individuals accumulate in compact masses, so closely packed as to allow of growth only upwards, and adhering very firmly to each other at the sides (Pl. XLVI, figs. 1 and 2). The young in such cases often attach themselves to the surface of the parent, so as at first sight to appear as if budding from it (Pl. XLVI, fig. 1). In the more free state, likewise, the spreading bases of several individuals sometimes come into contact and unite, but on careful inspection the line of union can generally be detected. The test, viewed as a transparent object under a microscope, always shows transverse anastomosing corrugations, but it often appears smooth to the naked eye, especially in the young state.

[*Styelopsis*] *grossularia* has been considered by English authors to be the *Ascidia rustica* of Linnæus. Müller appears to have been the first to mistake the young of that species; the description "*Junior hemispærica, mamillaris*," in his 'Prodromus,' and the smaller figures parasitical on the larger form in

'Zoologia Danica' [Plate xv, f. 3], being sufficiently characteristic of our animal. Continental authors, and I think rightly, have considered the larger (adult) form described by Müller to be the true *Ascidia rustica*. Having ascertained from specimens sent to me by the accomplished author, that Professor Van Beneden's *Ascidia grossularia* is identical with our British species, I do not hesitate to adopt his name. The *Cynthia gutta* of Stimpson appears also to be synonymous with this. The true *Ascidia rustica* of Müller has not hitherto been met with in this country.

2. [Styelopsis] sphærica *sp. nov.*

Ascidia rustica jun. O. F. Müller Zool. Danica, I [1788], p. 14 (*pars*), pl. xv, ff. 1, 2.

Body globose, finely corrugated transversely, attached to sea-weeds by a narrow base. *Apertures* nearly terminal, not far apart, small, smooth. *Test* semitransparent, with fine transverse corrugations, stronger and becoming somewhat puckered near the apertures. *Tentacular filaments* linear. *Branchial sac* with a single distinct fold on the left side, and a very slight one on the right, both situated near the oral lamina, which is smooth; the meshes longitudinal and much elongated. An *ovary* on the left side only, lying perpendicularly on the dorsal aspect.

Diameter rather above half an inch.

Hab.— ?

Ireland.—Killery Bay, Galway (*Thompson*).

First record.—Alder & Hancock; *coll.* Forbes, Ball, & Thompson, 1840.

A single specimen, apparently adult, with a young one attached, is preserved in Mr. Thompson's collection, now in the Belfast Museum. It is labelled "Killery Bay, 1840," and was got during an excursion of Messrs. Forbes, Ball, and Thompson to that locality;

it was probably considered by them to be a variety of *Ascidia rustica* of Müller. There appears, indeed, to be little doubt that it is identical with the second-sized figure under that name in Plate XV of the 'Zoologia Danica.' We believe, however, that the three sizes there figured by Müller as different stages of the growth of his *Ascidia rustica* are really three distinct species, and that the name must be retained for the largest or typical variety only. It thus becomes necessary to give a new appellation to the Ascidian now under consideration.

3. **[Styelopsis] lineata** *sp. nov.*

Body globose, deep red, attached. *Apertures* large, nearly circular, placed a little apart on conical protuberances of a paler colour than the body, lineated with longitudinal bands of a deeper colour, and within of an exquisite rose-red, a white line sometimes surrounding the rim. *Apertures*, branchial the larger and terminal, atrial a little to one side. *Test* thick, rugose, deep red. Gregarious.

Diameter about one fifth of an inch.

Hab.—On fuci.

England. — Salcombe Bay, Devon, dredged, the numerous individuals forming a dense mass about six inches in length, covering both sides of a fucus (*Hincks*).

First record.—Alder & Hancock; *coll.* Hincks.

For a knowledge of this species we are indebted to Mr. Hincks, from whose manuscript notes the above description is drawn up. He remarks that "the white rim and longitudinal rose lines are characteristic." Never having found similar markings in any of the allied species, I agree with him in thinking it distinct. It is nearly allied to [*S.*] *grossularia*.

4. **[Styelopsis] glomerata** (Alder).

(Pl. XLV, figs. 1 and (?) 2; Pl. XLVI, fig. 5.)

Cynthia glomerata Alder in Ann. Nat. Hist. (3) XI [1863], p. 166.

Body ovate or sub-globose, smooth, cherry-red, the individuals crowded into closely-adherent clusters. *Apertures* rather small, not far apart, very slightly prominent, quadrate, but sometimes appearing as a simple slit when closed. *Test* tough, rather shining, smooth or sometimes very slightly wrinkled in old individuals, closely adherent to the mantle. *Mantle* bright crimson. *Tentacular filaments* slender. *Branchial sac* red, with one large fold and a smaller one on the left side, and two or three small ones on the right, the largest folds being near the oral lamina, which is smooth. *Ovaries* disposed in small crimson pellets over the inside of the mantle.

Height from a quarter to nearly half an inch.

Hab.—Deep water (?).

Scotland.—Wick, Caithness; cast up after a storm (*Peach*).

First record.—Alder, 1863.

This interesting species differs from most of its congeners in the smoothness of its test, and in the little prominence of its apertures, which are generally level with the surface when closed. We are indebted to Mr. Peach for the beautiful group from which the description is taken (Pl. XLV, fig. 1; Pl. XLVI, fig. 5). It consists of a globular mass of individuals of all ages and sizes, piled upon each other so as to resemble a large fruit of the *Rubus* tribe. The extraneous substance to which they are attached is so completely covered as not to be discernible, and the individuals themselves adhere so closely that at first sight they appear to form one compound animal. That this is not the case, however, may be seen by a more minute inspection, when the lines of junction between

them can generally be detected, and, with a little care, an individual may be detached entire, showing no point of organic junction with the rest. The young fix themselves on all parts of the older ones and in the spaces between them, so that in process of time a globular group as here described is the result.

Genus 9. **THYLACIUM** V. Carus, 1851.

Thylacium Victor Carus in Proc. Ashmol. Soc. II [1851], p. 266; [Alder in Ann. Nat. Hist. (3) XI (1863), p. 167].*

Body elongated, oval, sessile, attached. *Test* coriaceous, opaque, adhering to the mantle. *Apertures*, both four-lobed. *Branchial sac* with fewer than eight folds, the meshes rectilinear. *Tentacular filaments* simple, linear. *Stomach* and *intestine* on the right side. *Individuals* associated by a creeping fibre on a common base. *Propagation* by gemmæ as well as by ova (?).

[The authors add: "The character to be revised," and they quote the original description of Dr. T. V. Carus, as follows:—] "Common base a broad fleshy structure supporting closely-set individuals; outer tunic coriaceous; both orifices with four lobes; abdomen as long as the thorax."

Dr. T. Victor Carus established the genus *Thylacium*, which he formed for the reception of an Ascidian found by him in the Scilly Islands, and to which he also added the previously-known *Ascidia aggregata* of Rathke. The apparent organic connection of the individuals of this genus by a solid fleshy base has induced the learned author to include it in the family Clavelinidæ, and to consider it to be propagated by gemmation as well as by ova. This may be the case, but the very close resemblance between the *Thylacium Sylvani* and some of the smaller gregarious *Cynthiæ* already described induces us to receive the opinion

* For generic synonyms see under *T. aggregatum* and *T. variolosum*.

with caution. Through the kindness of Dr. Acland we have had the opportunity of seeing the original specimen now in the Oxford Museum.

1. **Thylacium aggregatum** (Rathke) V. Carus.

(Plate XLVI, figs. 6–8.)

Ascidia aggregata Rathke in Müller's Zool. Danica, IV [1806], p. 11, pl. cxxx, [fig. 2].
Cynthia aggregata Forbes & Hanley Brit. Moll. I [1848], p. 41, pl. D, f. 5; [Ansted Channel Isl. (1862), p. 219].
Thylacium aggregatum Victor Carus in Proc. Ashmol. Soc. II [(1851), p. 268].

Body bottle-shaped, cylindrical, bright orange (or flesh-coloured), erect and adhering by a small base. *Apertures* terminal, approximate, of a deeper orange than the body and margined with red. *Test* (Pl. XLVI, figs. 6 and 7) nearly smooth, or slightly wrinkled, rather thin, sending out at the base slender root-like fibres, which are occasionally nodose. *Tentacular filaments* linear, stout, flattish, and tapering, alternately large and small. *Branchial sac* with two folds on each side. *Oral lamina* smooth, broad. *Ovaries* in two longitudinal rows near the back, curved a little at the base, bright orange or scarlet.

Length about an inch.

Var. **maculatum** *var. nov.* Smaller and rather more ventricose, of a flesh-colour spotted with red, minute fragments of shell adhering to the surface.

Hab.—Under large stones, in 12 fathoms water.

England.—Dartmouth, Devon; gregarious in vast numbers (*Forbes & McAndrew*). Scilly Isles (*Carus*).

Channel Islands.—Guernsey (*Norman & Alder*).

First record.—Forbes & Hanley, 1848; *coll.* Forbes & McAndrew, 1846.

[The habitat and localities apparently refer to both the type and the variety.]

2. **Thylacium Sylvani** V. Carus.

(Plate XLVI, figs. 9–11.)

Thylacium Sylvani Victor Carus in Proc. Ashmol. Soc. II [(1851), p. 268].

Body more or less globular or oblong-ovate, united in clusters to a common base, of a dark, dusky, ash-red colour, lighter when young. *Apertures* rather distant, on short conical papillæ, paler than the body. *Test* (Pl. XLVI, figs. 9–11) coriaceous, rough; (in specimen sent by the Rev. D. Ashford) reddish brown, rose-coloured when young. *Mantle* bright crimson or scarlet.

Height from a quarter to three-quarters of an inch.

Hab.—On the under-surface of overhanging rocks near low-water mark (*Carus*).

England.—Meledyon, White Isle, behind Sampson Island, Scilly Isles; gregarious in immense numbers (*Carus*).

First record.—Carus, 1850.

2. **Thylacium Normani** Alder.

(Plate XLV, figs. 3–5.)

Thylacium Normani Alder in Ann. Nat. Hist. (3) XI [1863], p. 167; [Norman in Rep. Brit. Assoc. for 1867 (1868), p. 439].

Body subclavate, rounded above and contracted a little below, reddish, firmly fixed in groups to a common fleshy base. *Apertures* rather large and prominent, set considerably apart at the upper end, quadrate, or nearly circular when expanded, sometimes appearing as a single slit when closed. *Test* (Pl. XLV, figs. 3–5) strongly wrinkled or sub-tuberculated, rather smoother near the apertures. *Tentacular filaments* linear, very slender. *Branchial sac* with two or three folds (?) on each side.

Height about two-tenths of an inch.

Hab.—Adhering to the roof and sides of caves (*Norman*).

Channel Islands.—Gouliot Caves, Sark (*Norman*).

Scotland.—[St. Margaret's Bay, Shetland; dredged, 1867 (*Norman*).]

First record.—Alder, 1863; *coll.* Norman [1859].

[Alder (*loc. cit.*) says that this species "is much smaller than the *T. Sylvani* of Carus, of a different form, and appears to spread more horizontally."]

4. **Thylacium variolosum** (Gaertner).

(Plate XLVI, figs. 12–14.)

Distomus variolosus Gaertner in Pallas' Spic. Zool. I, fasc. 10 [1774], p. 40; [Lamarck Hist. Nat. Anim. sans Vert. ed. 1, III (1816), p. 101, and ed. 2, III (1840), p. 498].

Alcyonium ascidioides Pallas Spic. Zool. I, fasc. 10 [1774], p. 40, pl. iv, ff. 7, 7a; [Gmelin Linnæi Syst. Nat. ed. 13, I, pt. 6 (1791), p. 3816;] Turton Brit. Fauna [1807], p. 208.

[*Alcyonium distomum* Bruguière Hist. Nat. Vers, I (1789), p. 23, in Encycl. Méth.; Bosc Hist. Nat. Vers, III (1802), p. 132; Lamouroux Polyp. Corall. flex. (1816), p. 352, and (transl.) Corallina (1824), p. 250.]

Distoma variolosum Savigny Mém. Anim. sans Vert. pt. 2 [1816], pp. 38, 178; [Lamouroux Exp. méth. Polyp. (1821), p. 73;] Forbes & Hanley Brit. Moll. I [1848], p. 19.

[*Distoma variolatus* Blainville Man. Malac. et Conch. (1825), p. 585; (1827), pl. lxxxvii, f. 4.]

[*Botryllus variolosus* Delle Chiaje Mem. Anim. senza Vert. III (1828), pp. 86, 94.]

Polyzoma variolosa Fleming Brit. Anim. [1828], p. 469.

Thylacium variegatum Alder in Ann. Nat. Hist. (3) XI [1863], p. 168.

Body (in each individual) transversely ovate, depressed, doridiform, shaded with flesh-colour and red. *Apertures* not much apart, on the upper surface, the branchial rather nearer the end. *Test* slightly

wrinkled or nearly smooth, generally red towards the anterior and paler towards the opposite end, with a whitish raised circle around each aperture, that of the branchial largest and radiated with red. *Individuals* (Pl. XLVI, figs. 12 and 13) connected by a membranous expansion, at the base, of a paler colour. *Tentacular filaments* linear, stout.

Length (transverse) of individuals about one-eighth of an inch. *Diameter* of the general mass one-half to three-quarters of an inch.

Hab.—On *Fucus palmatus* [? = *Rhodymenia palmata*] (*Gaertner*); on the test of *Cynthia* [*Styela*] *mamillaris* (*Jeffreys*); on the carapace of *Maia squinada* (*Norman*).

England.—Lulworth Cove, Dorset (*Jeffreys*). [Coast of Cornwall (*Gaertner*).]

Channel Islands.—Guernsey (*Norman*).

First record.—Gaertner [1774].

Genus 10. **PELONAIA*** Forbes & Goodsir, 1841.

Pelonaia Forbes & Goodsir [in Rep. Brit. Assoc. for 1840 (1841), Sect. p. 137, and] in Edinb. new Philos. Journ. XXXI (1841), p. 29; Forbes & Hanley Brit. Moll. I [1848], p. 42; Alder & Hancock in Trans. Tyneside Nat. Field Club, I [1848], p. 195; H. & A. Adams Gen. Recent Moll. II [1858], p. 593.

[*Ascidia* (pars) Dalyell Rare Anim. Scotl. II (1848), p. 141.]

Pelonæa Woodward Man. Moll. [1856], p. 338.

Animal free or very slightly adhering by glandular fibrils, elongated, cylindrical, vermiform, broadish and rounded or obtusely pointed towards the inferior end. *Apertures* 4-lobed, terminal, on short, conical papillæ. *Test* tough, closely adhering to the mantle. *Tentacular filaments* linear, small. *Branchial sac* without folds, extending two-thirds down the body; meshes rectilinear. *Stomach* and *intestine* sub-abdominal. *Reproductive organs* on both sides of the branchial or thoracic portion of the body.

* "Pelonæa" in the transcript of the authors' MS., throughout.

This curious genus, which very much resembles a *Sipunculus* in external form, and might readily be taken at first sight for a vermiform echinoderm, is nevertheless closely related to *Styela* in most of its characters. It differs from that genus, however, in its elongated form, in the absence of branchial folds, and more especially in the position of the stomach and intestine, which lie, for the most part, below the branchial sac, showing in this respect an approach to *Clavelina* and *Ciona*, and to those compound Ascidians in which the thorax and abdomen are distinct.

Pelonaia appears to be a boreal form, having yet been found only in the northern portion of Great Britain,* in Norway, and in North America. The species inhabit deepish water on a muddy or sandy bottom.

A detailed account of the internal structure was given by Forbes and Goodsir in their paper on this interesting genus in the 'Edinburgh New Philosophical Journal'; but as the anatomy of the animal was much misunderstood by these two eminent naturalists, we give the following description [of the anatomy of the typical species, *P. corrugata*] entirely from our own observations.

The test (Pl. XLVI, fig. 15) is not by any means thick; it is tough, opaque, and firm, with the external surface wrinkled transversely and covered with branched fibrils, most numerous at the inferior, enlarged and rounded, extremity. It is throughout strongly adherent to the mantle, from which it is with difficulty removed.

The mantle is considerably thinner than the test, and is provided with muscular fibres, of which the longitudinal ones are most conspicuous. It is almost colourless, being only slightly tinged with yellow.

The branchial sac (Pl. XLVI, fig. 16; Pl. XLVII, figs. 2 and 3; and fig. 81 in text) is very much elongated, though it does not reach to the bottom of the pallial chamber, the greater portion of the digestive apparatus

* [Both species, it will be seen later, are recorded from Cornwall.]

lying below it. The sac, which is much constricted above, widens gently downwards, and is a little produced at the base, towards the ventral margin, where the œsophagus enters it. It is composed of a simple, rectangular reticulation, in which the primary transverse vessels are regularly disposed, with smaller transverse channels between them. The meshes are parallelogrammatic, wide and rounded at the ends, and crossed about the middle by the small transverse vessels. The longitudinal cords are narrow ribbon-like membranes, attached by one edge to both the large and small primary vessels.

Fig. 81.—Part of the branchial sac of *Pelonaia corrugata*. Much enlarged.

The endostyle (Pl. XLVII, figs. 2 and 4) is well developed, and extends almost from one end of the sac to the other, there being only a very short distance between its lower end and the mouth. The oral lamina (Pl. XLVII, fig. 4) is a delicate, simple, smooth, widish membrane, which terminates below at the right side of the mouth, and above in the anterior cord which connects it with the extremity of the endostyle. The posterior cord is very short. The branchial tubercle (Pl. XLVII, fig. 4; Pl. XLVIII, fig. 18) has the extremities well turned inwards, the convolutions downwards, and the arched margin upwards. The

tentacular filaments (Pl. XLVII, fig. 4) are small, linear, and simple, nearly of equal size, from twelve to fourteen in number, arranged a little above the anterior margin of the branchial sac.

The branchial suspenders are well developed, and, as they are attached to the walls of the primary vessels, when the animal is contracted they are liable to draw the branchial organ into transverse wrinkles; this constantly happens with all those forms which have that organ much elongated.

The heart (Pl. XLVII, fig. 1) is a long, rather narrow, tube; it lies between the mantle and lining membrane on the left side, in a by no means wide pericardial chamber. The dorsal end advances a short way upwards, and on reaching the endostyle there terminates; the ventral extremity abuts against the cardiac end of the stomach, and sends a large trunk vessel to either side of that organ. The systemic circulation has not been further traced; the branchial circulation, however, is evident enough, and differs in no respect from that in *Ascidia*.

The nerve-ganglion (Pl. XLVII, fig. 4; Pl. XLVIII, fig. 18) is rather bulky, being less attenuated than usual, and the branchial tubercle rests upon its anterior extremity.

The mouth (Pl. XLVII, figs. 1–3) is circular, and opens into the base of the branchial sac towards the ventral margin. The œsophagus (Pl. XLVII, figs. 1–3) is much longer than usual, and passes downwards by the ventral margin almost to the bottom of the pallial chamber. It then suddenly turns upwards to reach the lower end of the stomach, which is an elongated, pyriform organ placed diagonally below the branchial sac, the attenuated or pyloric extremity passing upwards in the direction of the dorsal margin of the chamber. The intestine (Pl. XLVII, figs. 1–3) leaves this extremity of the stomach, and, ascending a little, turns inwards and downwards, and forms a small narrow loop. It then crosses to the ventral margin of

the chamber, in a deep sigmoidal curve, and, bending upwards, extends in a straight line to the cloaca. This, the rectal portion, is considerably wider than the pyloric extremity, and its walls are thin and membranous. The anus (Pl. XLVII, figs. 1–3) is a wide orifice with the margin reflected and divided into about twenty rounded lobes or denticulations. In the pyloric portion the mucous membrane is stout and is produced into a ridge along the left side, as evinced by a dark, groove-like line seen on the surface, similar to that observed in *Styela*. The mucous membrane of the stomach is likewise raised into numerous, close, regular, longitudinal plicæ. The lining of the œsophagus appears to be smooth.

The whole of the alimentary tube lies within a fold of the lining membrane, and thus becomes attached to the right-hand wall of the pallial chamber. The greater portion of the intestine merely bulges out this membrane; but the stomach and œsophagus project further into the pallial chamber, being, to a certain degree, suspended as it were by the infolding membrane. These organs are further steadied in their position by numerous, soft, tubercular nodules, similar to those associated with the genitalia in *Styela*, which stud both sides of the mantle at the lower extremity. The largest of these somewhat enigmatical bodies are found at the bottom of the pallial chamber, but they extend some little way upwards, diminishing in size and number.

The biliary duct (Pl. XLVII, fig. 1), which is single in this form, lies in a fold of the lining membrane, similar to that in *Styela*; it passes from the intestine to the right side of the pyloric end of the stomach. Before terminating, the duct receives a twig or two from the surface of the stomach, so that, in this genus, the liver is apparently not confined to the intestine, but is also partially spread over the stomach. The ultimate twigs divide dichotomously with considerable regularity; they are occasionally enlarged so as to

form elongated ampullæ, particularly at the points of division, and they terminate in round or ovate vesicles, which are very numerous, and form a distinct, opaque, yellow layer next to the surface of the intestine and stomach. The ducts and twigs are more superficial.

The reproductive system (Pl. XLVII, figs. 1–3, 6, and 7) exhibits a bilateral symmetry, as is the case with many of the *Cynthiadæ*. The ovaries are in *Pelonaia corrugata* divided into two portions which are attached respectively to the right and left sides of the pallial chamber, having the branchial sac between them, and the chief portion of the digestive organs behind. They lie between the mantle and the lining membrane, projecting in bold relief from the surface. Each is composed of both male and female parts; the latter, being much elongated and tubular, are bent, forming two wide loops that are turned downwards, the forks or limbs of which are of unequal length and directed upwards. The shorter limbs, which lie right and left of the endostyle, terminate in blind sacs; the longer limbs extend upwards, and, having the rectal portion of the intestine between them, terminate, far in advance of the anus, in short, slender oviducts, one on each side of, but considerably above, the anus; the extremities of the oviducts become free, and, projecting from the pallial wall, open into the cloaca.

The two lengthened ovigerous organs are fringed on either side with numerous, elongated, simple, or lobed vesicles composing the testis (Pl. XLVII, figs. 6 and 7), which are placed with one end in contact with the sides of the ovaries, and are arranged in parallel order at right angles to them. From the proximal extremities of the vesicles extremely delicate ducts pass across the surface of the ovary to which they are attached, and go, frequently united in pairs, to join the vas deferens, which extends along the middle line from end to end of each ovigerous organ, and, advancing along the oviduct, terminates at the extremity of that tube.

These compound generative organs have a very peculiar appearance, on account of their remarkable form and the symmetrical arrangement of their parts, enhanced by their colour; the tubular ovaries being of a bright yellow-ochre colour, and the fringing, male vesicles, almost white.

1. **Pelonaia corrugata** Forbes & Goodsir.

(Pl. XLVI, figs. 15 and 16; Pl. XLVII; Pl. XLVIII, fig. 18; and figs. 81 and 82 in text.)

Pelonaia corrugata Forbes & Goodsir [in Rep. Brit. Assoc. for 1840 (1841), Sect. p. 138, and] in Edinb. new Philos. Journ. XXXI [(1841), p. 30, pl. i, f. 1]; Forbes & Hanley Brit. Moll. I [1848], p. 43, pl. E, f. 4; Alder & Hancock in Trans. Tyneside Nat. Field Club, I [1848], p. 195; [Alder in Trans. Tyneside Nat. Field Club, I (1850), p. 365; Cocks in Rep. R. Cornw. Polyt. Soc. 1849 (1850), p. 72; Norman in Zoologist, XV (1857), p. 5708; H. & A. Adams Gen. Recent. Moll. II (1858), pl. cxxxiii, f. 4; Bronn Thier-Reichs, III, 1 (1861), p. 121; Alder in Nat. Hist. Trans. Northumb. Durh. I (1865), p. 11; McIntosh in Ann. Nat. Hist. (3) XIX (1867), p. 414; in Rep. Brit. Assoc. for 1866 (1867), Sect. p. 76; and *op. cit.* for 1867 (1868), p. 92; Norman in Rep. Brit. Assoc. for 1868 (1869), p. 302; M. & G. O. Sars Christianiafjord. Fauna, pt. 2 (1870), p. 102].

Ascidia villosa Dalyell Rare Anim. Scotl. II [1848], p. 141.

? Pelonaia arenifera Stimpson [in Proc. Boston Soc. Nat. Hist. IV (1851), p. 49].

? Pelonaia villosa Sars in Forh. Vid.-Selsk. Christ. 1858 [(1859), p. 66].

[*Pelonaia rugosa* Bronn Thier-Reichs, III, 1 (1861), pl. xiii, f. 19.]

Body much elongated, vermiform or flask-shaped, tapering upwards, broader and more rounded below, and terminating posteriorly in an obtuse point. *Apertures* closely approximated at the upper end, on small conical papillose tubes, with a red margin. *Test* (Pl. XLVI, fig. 15) deep brown, opaque, strongly corrugated transversely, hispid and smoother at the lower end; usually covered with grains of sand. *Mantle*

rather thin, semitransparent, orange-coloured. *Tentacular filaments* small, short, and slightly obtuse. *Branchial sac* (Pl. XLVI, fig. 16, and fig. 81 in text) with rather distant rows of elliptical stomata.

Length [two and a half inches].

Hab.—Deep water [in the mud-filled cavities of old shells].

England.—[Berwick (*Johnston*);] Cullercoats, from the fishing-boats, rare (*Alder*, 1848); Northumb. Seaham Harbour (*Hodge*); [Whitburn (Alder, 1850);] Durham. [Falmouth, Cornwall; in trawl refuse (*Cocks*, 1849).]

Scotland.—[Anstruther (*Forbes & Goodsir*, 1840); St. Andrews (*McIntosh*, 1866); Fife.] Firth of Forth (*Dalyell*, 1848). [Off Shell Bay, Cumbrae, Firth of Clyde, in 6 to 15 fathoms (*Norman*, 1857). Island of Balta, Shetland (*Norman*, 1868).]

First record.—Forbes & Goodsir (1840); *coll.* Goodsir.

Forbes and Goodsir do not notice the villose surface of this species, by means of which it is generally more or less covered with fine sand or mud. The *P. villosa* of Sars, separated from it on account of this character, is, we have no doubt, the same species, as is also probably the *P. arenifera* of Stimpson. Its range therefore appears to extend to Finmark in the Arctic seas, and to Massachusetts Bay in North America.

2. **Pelonaia glabra** Forbes & Goodsir.

(Figs. 83 and 84.)

Pelonaia glabra Forbes & Goodsir [in Rep. Brit. Assoc. for 1840 (1841), Sect. p. 128, and] in Edinb. new Philos. Journ. XXXI [1841], p. 30, pl. i, ff. 2, 3; Forbes & Hanley Brit. Moll. I [1848], p. 43; [Cocks in Rep. R. Cornw. Polyt. Soc. 1849 (1850), p. 243; Rupert Jones in Cycl. Anat. IV, pt. 40 (1850), p. 1239, f. 789; Forbes in Rep. Brit. Assoc. for 1850 (1851), p. 242; Norman in Zoologist, XV (1857), p. 5708].

[*Pelonæa glabra* Woodward Man. Moll. (1856), p. 338, pl. xxiv, f. 3.]

[*Pelonaia lævis* Bronn Thier-Reichs, III, 1 (1861), pl. xiii, ff. 20, 21.]

Body "not nearly so much elongated as the last. *Test* greenish-yellow, smooth, pilose" [*Forbes & Goodsir*]. Thin and diaphanous like parchment.

Hab. — Seven fathoms water, in mud (*Goodsir*). [Nine fathoms (*Forbes*).]

England.—[Helford River, Falmouth, Cornwall, in trawl refuse (*Cocks*, 1849).]

Scotland.—[Firth of Clyde (*Forbes*, 1850; *Norman*, 1857).] Rothsay Bay, Bute (*Goodsir*, 1840).

First record.—Forbes & Goodsir (1840); *coll.* Goodsir.

Fig. 82.

Fig. 83.

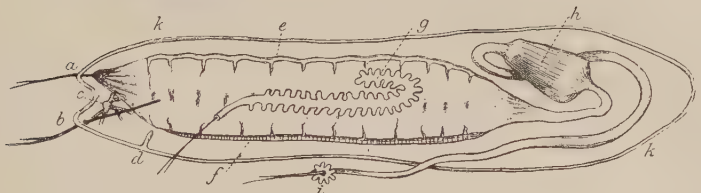


Fig. 84.

Fig. 82.—*Pelonaia corrugata.* Fig. 83.—*Pelonaia glabra.* Both natural size. *a*, Oral orifice [branchial]; *b*, anal orifice [atrial]. Fig. 84.—Anatomy of *P. glabra*; three times natural size. "*a*, a bristle inserted into the respiratory sac through the oral orifice; *b*, a bristle inserted in the mantle-cavity through the anal orifice of the test; *c*, ganglion with the nerves proceeding from it; *d*, the shelf or transverse ridge in the interior of the test and mantle; *e*, branchial vein inclosed in a serpentine band . . . ; *f*, branchial artery; *g*, generative organ of the left side, with a bristle inserted into its duct; *h*, the stomach; *i*, anus; *kk*, cut edge of the test." (*Forbes & Goodsir* in Edinb. new Philos. Journ. xxxi, p. 34, pl. i, ff. 1–3.)

This species differs from the last in the characters above given, and in some minute anatomical details pointed out by Professor Goodsir in his excellent paper on the anatomy of the genus. It has not come under our observation.

Family 4. Clavelinidæ.

Animal more or less clavate, pedunculated; attached at the base and united into groups by a creeping fibre or connective stolon. *Tunic* very transparent. *Apertures* with or without rays. *Reproduction* by ova or by buds arising from the stoloniferous base.

Genus 11. **Clavelina** Savigny, 1809.

[*Ascidia* (pars) O. F. Müller Zool. Danica, II (1788), p. 54.] *Clavelina* Savigny [in Descr. Égypt, Hist. Nat. I (1809), pt. 2, p. 46, and] Mém. Anim. sans Vert. pt. 2 (1816), p. 171; Fleming Brit. Anim. [1828], p. 468; Milne Edwards Obs. Ascidies comp. [in Mém. Acad. Sci. Inst. France, XVIII (1842)], p. 50; Forbes & Hanley Brit. Moll. I [1848], p. 26; Alder & Hancock in Trans. Tyneside Nat. Field Club, [I (1848), p. 202;] Gosse Man. Marine Zool. II [1856], p. 34; H. & A. Adams Gen. Recent Moll. II [1858], p. 593.

Animal elongated, erect, claviform, consisting of a distinct thorax and abdomen; attached at the base, the individuals united into groups by tubular root-like prolongations. *Apertures* circular, terminal, without segments or ocelli. *Test* smooth, transparent, scarcely adhering to the body, except at the two apertures. *Mantle* membranous, transparent, the thorax usually marked with coloured or opaque white lines. *Tentacular filaments* linear. *Branchial sac* without folds, the meshes nearly rectilinear or elliptic oblong, occupying the upper or thoracic portion of the body, the peduncle or abdominal portion containing the stomach and reproductive organs.

The organization of the *Clavelinæ* has been given in a very complete manner by Milne Edwards, in his admirable memoir on the Compound Ascidians. He had the advantage of making his observations on the living organism, a valuable privilege which we have not enjoyed; but as these animals retain much of their

transparency when preserved in spirit, and especially as *C. lepadiformis* is large enough for successful dissection, considerable information may be acquired from specimens in this state.

The test (Pl. XLIX, fig. 1) is smooth, perfectly hyaline, thin, semi-cartilaginous, and elastic; it adheres to the mantle, but can be removed with ease.

The mantle is diaphanous, very delicate, and membranous; it is not very muscular, the fibres being only feebly developed. A few longitudinal, widely-separated fibres are observed in the thoracic portion; but the longitudinal contractions would seem to be mainly dependent on two rather stout bundles of fibres which pass from the thorax to near the lower extremity of the abdomen, in the wall of which their extremities are inserted.

In this form the thorax and abdomen are distinct. In the former the branchial sac is suspended; in the latter the digestive and reproductive organs are lodged.

The branchial sac (Pl. L, fig. 1) nearly fills the thoracic portion, and extends the full length of the cavity, leaving on each side the atrial spaces, and the cloaca in front. The aerating surface is a simple, rectangular network, in which the meshes are narrower and longer than usual (Pl. XLIX, fig. 2); they are formed by secondary vessels extending vertically between the large transverse or primary channels, of which there are fourteen or fifteen of about equal size, placed at regular intervals. The walls of those vessels give support to as many ribbon-like membranes, which reach from the endostyle to the oral filaments, and are arranged along the ventral margin occupying the place of the usual oral lamina. The free margins of those ribbon-like membranes project into the branchial cavity and appear to be bounded by a small vessel, the surface of which seems to be ciliated. These membranes are undoubtedly the homologues of the transverse membranes in connexion with the branchial papillæ in

Ascidia; but in *Clavelina* there are no longitudinal cords to interrupt their continuity.

The anterior cord in connexion with the upper extremity of the endostyle is well developed; but the posterior cord has disappeared, for the lower end of the endostyle reaches the margin of the oral orifice, and thus the space it usually occupies is obliterated. The branchial tubercle is small and circular, but more respecting it could not be determined.

The oral lamina, as above stated, is replaced in *Clavelina* by a longitudinal series of large filamentous processes, tapering to points, and with their bases widened transversely and united to the transverse branchial membrane; there are as many processes as laminæ, namely fourteen or fifteen.

There are two circles of simple tentacular filaments a little within the entrance of the inhalant tube, one a short way above the other. In the upper circle the tentacles are small and more numerous than those of the lower circle, in which there are about six which are very superior in size to the others.

The endostyle is largely developed, extending the whole length of the branchial sac, and being united below to the margin of the mouth. It is of an opaque yellow colour, is firm, and wider than usual, the margin of the groove being thrown more backwards. It is composed of three members, a broad central plate-like rod, and two narrow lateral rods, the free margins of which are delicate and membranous. The central rod exhibits a median line as if it were composed of two longitudinal elements.

The heart lies at the left side of the intestinal loop; and, according to Milne Edwards, is lodged within a delicate pericardium. It is tubular and is bent upon itself. The branchial suspenders are as well developed and as numerous as usual.

The mouth is a large rounded orifice opening into the bottom of the branchial sac at an angle inclined backwards. From this point the œsophagus descends

in a straight line as a wide equal tube, retaining its diameter until it reaches the upper or cardiac end of the stomach, when it suddenly contracts and becomes united to that viscus. The stomach is rounded and somewhat elongated, and is considerably wider than the rest of the alimentary tube, hanging, as it were, from the œsophagus towards the ventral wall of the abdominal chamber. It is of a full yellow colour, with firm walls which are divided externally into three or four longitudinal facets by as many pale, ridge-like septæ. The intestine leaves the lower end of the stomach, and, dropping downwards, is almost immediately constricted; it then widens again, and on approaching the bottom of the chamber once more suddenly contracts, and then, as suddenly regaining its former calibre, turns towards the dorsal margin, ascends on this side of the stomach, crosses on the right of the œsophagus, and terminates in the anal orifice within the base of the cloaca a little above the level of the mouth.

The alimentary tube does not lie free in the abdominal chamber; but it is adherent to the wall apparently by a fold of the lining membrane, the œsophagus, stomach, and intestine being bound as it were in a peritoneal sac.

In this genus there is only one hepatic duct; it is a short, narrow tube, which passes from the intestine a little above the loop, and carries the biliary secretion into the dorsal side of the intestine immediately below the stomach. The branches of the duct ramify over the intestinal tube, dividing dichotomously, and ending in comparatively-large oval vesicles, which are scattered over the surface of the intestine from a little above the loop to a short way in advance of the level of the upper extremity of the stomach.

The nervous system is not conspicuously developed. A small ganglion can be observed in the usual situation between the two respiratory tubes. The nerves have not been traced.

The genitalia are placed in the loop of the intestine near to the lower extremity of the abdominal cavity, the ovary appearing on the right of the alimentary tube, the testis being spread over both sides of it. The ovary is a rather conspicuous organ in the form of a bunch of grapes, in which the berries are of various sizes. The oviduct or central support, like the stem of the fruit, is seen in the midst of the ova; but how the eggs find their way to the atrium, where they appear to be incubated, is not known.

The testis is a much-branched organ, the ramifications are extremely fine, and, dividing dichotomously, terminate in numerous, elongated, fusiform vesicles which are united in pairs; or in other words the ultimate twigs may be said to bifurcate, each branch being immediately enlarged so as to form an elongated cæcal vesicle. The vas deferens originating in this organ is sufficiently conspicuous; passing up by the right side of the alimentary tube, it penetrates the lower wall of the cloaca, and terminates by the side of the anal outlet.

1. **Clavelina lepadiformis** (O. F. Müller) Savigny.

(Plate XLIX, figs. 1 and 2; Pl. L.)

Ascidia lepadiformis O. F. Müller Zool. Dan. Prodr. [1776], p. 226, no. 2738; [Zool. Dan. Icon. II (1780), pl. lxxix, f. 5; Zool. Dan. Descr. II (1784), p. 119; and] Zool. Danica, II [1788], p. 54, pl. lxxix, f. 5; Bruguière Hist. Nat. Vers [I (1789),] p. 151, in Encycl. Méth.; [Bory de St. Vincent Vers, etc. (1791), p. 135, pl. clxiii, f. 10, in Tabl. Encycl. Méth.; Gmelin Linnæi Syst. Nat. ed. 13, I, pt. 6 (1791), p. 3126; Bosc Hist. Nat. Vers (1802), p. 106; Turton Gen. Syst. Nat. IV (1802), p. 95;] Lamarck Hist. Nat. Anim. sans Vert [ed. 1, III (1816), p. 126, and] ed. 2, III [1840], p. 533; [Stark Elem. Nat. Hist. II (1828), p. 117; (?) Schultze in Zeits. f. wiss. Zool. II, 2 (1862), p. 178].

Ascidia gelatina Rathke in Müller's Zool. Danica, IV [1806], p. 26, pl. cxliii. (Non [*Ascidia gelatinosa*] Linnæus [Syst. Nat. ed. 12, I, pt. 2 (1767), p. 1087].)

Clavelina lepadiformis Savigny [in Descr. Égypt., Hist. Nat. I (1809), pt. 2, p. 46; and] Mém. Anim. sans Vert. pt. 2 [1816], pp. 110, 174, (?) 237; Fleming [in Edinb. Encycl. XIV, pt. 2 (1820), p. 631;] Brit. Anim. [1828], p. 468; [and Moll. Anim. (1837), p. 202, pl. xvi, f. 57; Thompson in Ann. Nat. Hist. (1) V (1840), p. 95;] Milne Edwards Obs. Ascidies Comp. [in Mém. Acad. Sci. Inst. France, XVIII (1842),] p. 266, pl. i, f. 1, pl. ii, f. 1; [Deshayes Moll. in Cuvier's Règne Anim. (1836–49), pl. cxxvii, ff. 2, 2a;] Forbes & Hanley Brit. Moll. I [1848], p. 26, pl. E, ff. 1a, 1b; Alder & Hancock in Trans. Tyneside Nat. Field Club, I [1848], p. 202; [Cocks in Rep. R. Cornw. Polyt. Soc. 1849 (1850), p. 73; Rupert Jones in Cycl. Anat. IV, pt. 40 (1850), p. 1196; Carus in Proc. Ashmol. Soc. II (1851), p. 267;] Gosse [Man. Marine Zool. II (1856), p. 34, f. 52, and] Tenby [1856], pp. 63, 162, pls. v, vi; [Hoeven Handb. Zool. II (1856), p. 706;] Thompson Nat. Hist. Ireland, IV [1856], p. 361; [Woodward Man. Moll. (1856), p. 339, pl. xxix, f. 6; Huxley in Carus' Icon. Zootom. I (1857), pl. xviii, ff. 17, 18; Norman in Zoologist, XV (1857), p. 5707; H. & A. Adams Gen. Recent Moll. II (1858), pl. cxxxiii, f. 7; Chenu Encycl. Hist. Nat., Moll., etc. (1858), p. 246; Dickie in Rep. Brit. Assoc. for 1857 (1858), pp. 105, 111; Bronn Thier-Reichs, III, 1 (1861), p. 128, etc., pl. xii, ff. 11, 21; pl. xv, ff. 22–29; Ansted & Latham Channel Isl. (1862), p. 219; Alder in Nat. Hist. Trans. Northumb. Durh. I (1865), p. 11, and in Rep. Brit. Assoc. for 1866 (1867), p. 208; Norman in Rep. Brit. Assoc. for 1868 (1869), p. 303].

Body elongate, hyaline, the thoracic portion enlarged and forming about a third (or sometimes nearly one half) of the whole animal; marked with yellow or opaque white lines; two longitudinal, and two less conspicuous circular ones, circumscribing the branchial sac. *Apertures* not far apart, the branchial terminal and largest, the atrial slightly to one side, both with even rims, and occasionally margined with an opaque line. *Test* and *mantle* perfectly transparent and colourless, showing the viscera through; the stomach appearing as a bilobed orange mass with white lines, half way down the peduncle. *Branchial sac* with twelve or fourteen rows of elliptic oblong meshes.

Length from three-quarters of an inch to one inch. Generally associated in clusters united by a stoloniferous base.

Hab.—On rocks, stones, etc., at and beyond low water-mark, on most parts of our coasts, more especially in the south and west.

England.—[(?) English Coast (Savigny, 1816).] Whitley, Northumb. (*Hancock*). Torbay and Salcombe, Devon (*Hincks*, and *Alder*). [Gwyllyn-vase, Pennance, etc., Falmouth (*Cocks*, 1849); and] Fowey Harbour (*Peach*); Cornwall. [Scilly Isles (*Carus*, 1850).]

Scotland.—Oban, Argyll; Lamlash, Arran; and Bute (*Alder*). [Kirkwall Bay, Orkney (*Fleming*, 1828). Lamlash Bay and Rothesay Bay (*Norman*, 1857).] Shetland (*Jeffreys*). [One mile east of Whalsey Lighthouse, Shetland, 1861 (*Norman*, 1868).]

Ireland.—Strangford Lough, Down (*Thompson*, 1840). Connemara, Galway (*Forbes*, 1848).

Channel Islands.—Guernsey and Herm (*Alder*).

First record.—[(?) Savigny, 1816; *coll.* Leach; or Fleming, 1828.]

2. **Clavelina producta** Milne Edwards.

Clavelina producta Milne Edwards Obs. Ascidies comp. [in Mém. Acad. Sci. Inst. France (1841), p. 278,] pl. i, f. 2, and pl. ii, f. 3; Rupert Jones in Cyclop. Anat. IV, pt. 40 (1850), p. 1188, f. 768].

Body much elongated, slender, transparent; the thorax short, and nearly as broad as long, without perceptible opaque lines. *Branchial sac* with only three rows of meshes. Abdominal portion of peduncle very long, four or five times the length of the thorax; the stomach appearing of a yellow colour near the base.

Length three-quarters of an inch.

Hab.—Rock pools (*Gosse*).

Wales.—St. Catherine's Island, Tenby, Pembroke (*Gosse*).

First record.—Gosse, 1856.

3. **Clavelina corrugata** *sp. nov.*

(Plate XLIX, fig. 3.)

Body cylindrical, slightly swelling in the thoracic portion, which forms about a third of the whole length. *Thorax* nearly as broad as long, the opaque lines of a pinkish colour, the dorsal one much curved. *Test* sub-diaphanous, colourless, strongly corrugated with irregular transverse wrinkles. *Branchial sac* with fourteen or fifteen rows of meshes. *Peduncle* rather thick.

Length half to three-quarters of an inch.

Hab.—Low water-mark, on stones (*Alder*).

England.—Torbay (*Alder*), and Ilfracombe (*Hincks*), Devon.

First record.—Alder & Hancock.

Genus 12. **PEROPHORA** Wiegmann, 1835.

[*Ascidia* Lister in Phil. Trans. 1834, p. 378.]

Perophora Wiegmann Archiv f. Naturgesch. 1835 [I, p. 309]; Forbes & Hanley Brit. Moll. I [1848], p. 28; Gosse Man. Marine Zool. II [1856], p. 35; Woodward Man. Moll. [1856], p. 341.

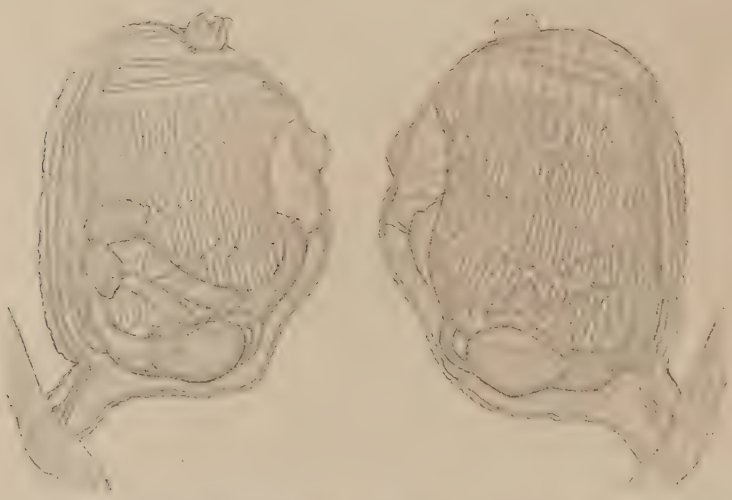
Animal orbicular or sub-quadrate, compressed at the sides and united by a short peduncle to a creeping, tubular fibre, common to several individuals; without opaque white or coloured lines. *Test* united to mantle. *Thorax* and *abdomen* not distinct, the intestine being placed at the right side of the branchial sac. *Apertures* plain or indistinctly divided into four segments; without ocelli.

We have never had an opportunity of examining this interesting form in a living state; but as in preserved specimens its transparency is scarcely at all impaired, it is not difficult to investigate its internal organization by transmitted light, even in this state, with the exception of the circulatory apparatus, which

can only be determined, in so minute a creature, in living specimens. The blood-system, however, in the living *Perophora*, has been very carefully observed by Dr. Lister and ably described by that physiologist, in his excellent memoir published in the 'Philosophical Transactions,' where the author has given a full account of the circulation in this animal.

The test is thin, elastic, smooth, and perfectly hyaline, and is united to the mantle throughout. The

Fig. 85. Fig. 86.



Figs. 85 and 86.—*Perophora Listeri*. 85, right side; 86, left side. Twenty times natural size.

latter is exceedingly delicate and transparent, with a few muscular fibres arranged longitudinally and diagonally in a scattered manner; they extend from the upper margin, in the region of the respiratory tubes on both sides of the mantle, to about half way down.

The branchial sac is of a sub-quadrate form, and is almost co-extensive with the pallial chamber. The meshes are rectilinear; there are only three transverse primary vessels, consequently only four rows of meshes or stigmata, which are proportionately large. The

external surface of the primary vessels exhibits a few dots, probably indicative of the branchial suspenders, and there is some appearance of transverse ribbon-like membranes, similar to those in *Clavelina*, projecting into the cavity of the organ, from these same vessels.

The endostyle is broad, with the ends obtuse. It extends some way above the upper margin of the branchial sac, and it reaches below to the bottom of this organ, the posterior end being a little bent forward or inward. The anterior cord is wider than usual.

[Dr. Lister states that the heart is placed "near the bottom of the branchial sac on the left side (fig. 86), and consists of a transparent ventricle . . . running forward and a little sloping downward in a channel hollowed to contain it."] The two vessels proceeding from the heart to the stoloniferous stem are easily observed in their course through the peduncle. They are seen as if originating in the great dorsal, branchial channel, though undoubtedly only one of them so originates.

The digestive organs are placed for the most part on the right side (fig. 85) of the branchial sac, the œsophagus and much of the stomach, however, lie below it at the bottom of the pallial chamber.

The mouth opens through the lower extremity of the branchial sac, close to the ventral margin. The œsophagus, which is a narrow tube of some length, dips downwards and backwards in an even curve to its union with the ventral end of the stomach. This latter viscus is an ovate bulb, lying transversely at the bottom of the pallial chamber, the narrow or dorsal extremity of which graduates into the intestine.

The intestine is wide, and passes backwards as far as the endostyle, and then, arching upwards, shortly turns towards the ventral side, at this point being somewhat enlarged; dipping downwards and forwards it ascends a little to reach the cloaca, where it terminates in a rather wide anal orifice. The intestinal

tube therefore forms an open transverse loop, and that which may be termed the rectal portion assumes a regular sigmoidal curve.

The liver is composed of numerous, large, oval vesicles, scattered over the rectal portion of the intestine. The minute twigs of the duct divide dichotomously, and terminate in the vesicles, the points of division being usually enlarged into ampullæ. The twigs unite and go to form a slender, short duct, which passes from the intestine to the right side of the stomach at the pyloric extremity, where the hepatic fluid is mingled with the nutritive matters.

The reproductive organs are situated within the loop of the intestine, but their structure has not been determined. The eggs, however, are apparently incubated in the atrium at the sides of the branchial sac, as we have seen the incipient tadpole larvæ in this position.

1. **Perophora Listeri** [Forbes & Hanley].*

(Figs. 85 & 86.)

Ascidia Lister in Phil. Trans. 1834, p. 378, pl. xi; [Fleming Moll. Anim. (1837), p. 202, pl. xvii, f. 59].
Perophora Wiegmann Archiv f. Naturgesch. 1835 [I, p. 309].
Perophora Listeri Forbes & Hanley Brit. Moll. I [1848], p. 28, pl. E, ff. 2a, 2b; [Cocks in Rep. R. Cornw. Polyt. Soc. 1849 (1850), p. 73; Huxley in Carus' Icon. Zootom. I (1851), pl. xviii, ff. 20, 21;] Gosse Nat. Rambles Devon. Coast [1853], p. 241, pl. xv, ff. 1, 2; [Hoeven Handb. Zool. II (1856), p. 706; Woodward Man. Moll. (1856), p. 340, pl. xxvii, f. 7; H. & A. Adams Gen. Recent Moll. II (1858), pl. cxxxiii, f. 8; Owen in Encycl. Brit. ed. 8, XV (1858), p. 332, f. 15 on p. 321; Bronn Thier-Reichs, III, 1 (1861), pl. xvi, ff. 8–15].

* Forbes & Hanley (*loc. cit. infra*) and subsequent writers refer this species to Wiegmann, but in his notice of Dr. Lister's paper he only gave the name *Perophora* to the genus. The authors of this monograph leave the authority for the specific name blank here, but give it as Wiegmann in their synonymy, apparently having suspected that he was not the author of it.

Body sub-orbicular, vitreous, transparent, white with orange and brown specks from the viscera showing through. *Apertures* large. *Tentacular filaments* short, uneven. *Branchial sac* with four rows of elliptical stigmata. *Oral lamina* with filaments.

Diameter not quite one-tenth of an inch.

Hab.—Adhering to Confervæ and sea-weeds.

England.—Not uncommon on the South Coast. Brighton, Sussex, on *Conferva* [*Polysiphonia*] *elongata* (*Lister*, 1834). Ilfracombe, Devon (*Gosse*; *Hincks*). [Gwyllynvase, Swanpool, etc., Falmouth, Cornwall, attached to the fronds of *Fucus serratus*, etc. (*Cocks*, 1849).]

Wales.—Coast of Anglesey, adhering to sea-weed; dredged, 1843 (*Forbes & McAndrew*).

Ireland.—[In the Irish Sea (*Forbes & Hanley*, 1848).]

First record.—Lister, 1834 [; *coll.* 1833].

Genus 13. **DIAZONA** Savigny, 1809.

Diazona Savigny [in Descr. Égypt., Hist. Nat. I (1809), pt. 2, p. 23, and] Mém. Anim. sans Vert. pt. 2 [1816], p. 174; Woodward Man. Moll. [1856], p. 342.

Syntethys Forbes & Goodsir in Trans. Royal Soc. Edinb. XX (1851) [pt. 2, p. 307]; Forbes & Hanley Brit. Moll. IV [1853], p. 244; Woodward Man. Moll. [1856], p. 340; Gosse Man. Marine Zool. II [1856], p. 34.

[*Diazoma* Lamarck Hist. Nat. Anim. sans Vert. ed. 1, III (1816), p. 101.]

General mass gelatinous, sub-globose, sessile, attached. *Individuals* much elongated, forming a single, irregular, or very indistinctly-concentric system; their upper or thoracic portion free, the lower or abdominal enclosed in the general mass. *Apertures* terminal, and 6-lobed, the branchial the larger; without ocelli. *Tentacular filaments* linear. *Branchial sac* without folds, the intersections of the meshes papillated. *Ovaries* in the intestinal loop.

1. **Diazona hebridica** (Forbes & Goodsir) Alder.*

(Plate XLIX, figs 4–6.)

[*Diazona violacea* Savigny in Descr. Égypt., Hist. Nat. I (1809), pt. 2, p. 23, and Mém. Anim. sans Vert. pt. 2 (1816), pp. 35, 61, 116, 175, pl. ii, f. 3, and pl. xii; Fleming in Edinb. Encycl. XIV (1820), p. 631; Philos. Zool. II (1822), p. 512; and Moll. Anim. (1837), p. 211; Eichwald Zool. Spec. I (1829), p. 269; Deshayes Moll. in Cuvier's Règne Anim. (1836–1849), pl. cxxxii, f. 1; Leunis Synops. Naturreich, I, Zool. (1844), p. 412; Rupert Jones in Cyclop. Anat. IV, pt. 40 (1850), pp. 1191, 1197, f. 770; Hoeven Handb. Zool. I (1856), p. 704; Woodward Man. Moll. (1856), p. 342, pl. xxiv, f. 13; Owen in Encycl. Brit. ed. 8, XV (1858), p. 332; Bronn Thier-Reichs, III, 1 (1861), p. 117, pl. xii, f. 12, and pl. xiii, f. 13.]

[*Diazona mediterranea* Lamarck Hist. Nat. Anim. sans Vert. ed. 1, III (1816), p. 102; Stark Elem. Nat. Hist. II (1828), p. 120.]

[*Polyclinum diazona* Cuvier Règne Anim. ed. 1, iv (1817), pl. xi, f. 6; ed. 2, III (1830), pl. xiv, f. 6; and (transl.), Anim. Kingd. III (1837), pl. x, f. 6.]

[*Diazona mediterranea* Risso Hist. Nat. Europe mérid. IV (1826), p. 277; Dujardin in Lamarck's Hist. Nat. Anim. sans Vert. ed. 2, III (1840), p. 499.]

Syntethys hebridicus Forbes & Goodsir in Trans. Roy. Soc. Edinb. XX (1851) [pt. 2, p. 309, pl. ix, f. 4a]; [Forbes in Brit. Assoc. Rep. for 1850 (1851), p. 242;] Forbes & Hanley Brit. Moll. IV (1853), p. 244; [Woodward Man. Moll. (1856), p. 340; H. & A. Adams Gen. Recent Moll. II (1858), pl. cxxxii, ff. 9, 9a].

[*Diazona hebridica* Alder in Ansted's Channel Isl. (1862), p. 219; in Ann. Nat. Hist. (3) XI (1863), p. 169; and in Rep. Brit. Assoc. for 1866 (1867), p. 208.]

Common base massive, transparent, greenish white, broadly cylindrical. *Individuals* rather slender. *Thoraæ* elongated, yellowish-green with a circular opaque white line above, two similar longitudinal lines on the ventral, and one on the dorsal aspect. *Apertures* terminal, tubular, the branchial central, the atrial

* [That this is Savigny's *Diazona violacea* there can now be no doubt.]

slender and situated a little to one side. *Mantle* muscular, highly contractile. *Branchial sac* with numerous rows of oblong meshes, the intersections with large papillæ. *Oral lamina* with long filaments, broad at the base and triangular. *Abdomen* reddish, enveloped in the general mass.

Length of individuals about two inches. Common mass sometimes six inches in diameter.

Hab.—Deep water.

England.—The Ascidian got by Mr. Couch from deep water on the Cornish coast, and exhibited at the meeting of the British Association at Plymouth [1841] probably belongs to this species.

Scotland.—Close to Croulin Island, near Applecross, Ross, dredged in 30 fathoms water (*McAndrew*).

Channel Islands.—Guernsey (*Alder; Norman*).

First record.—Forbes & Goodsir, 1850; *coll.* McAndrew.

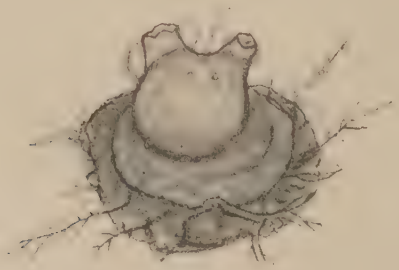
That the *Syntethys hebridicus* of Forbes and Goodsir is really a *Diazona*, will, we think, be obvious to any one who has the opportunity of carefully investigating its characters, one or two of which appear to have escaped the observation of those distinguished naturalists who first described it. The division of the apertures into six lobes is very difficult to make out, except in well-preserved specimens, and the elongated and pedunculated form of the abdomen is a character varying exceedingly according to the degree of contraction in which the animal is seen.

Mr. Alder was so fortunate as to dredge large masses of this remarkable Ascidian at Guernsey in 1853, and had the opportunity of examining it in a living state, when it was at once recognized as the *Syntethys hebridicus* of Forbes and Goodsir; but on placing specimens in spirits the pale apple-green colour of the living animals (Pl. XLIX, fig. 5) began to change into a delicate violet, and the whole put on the appearance of the *Diazona violacea* of Savigny. This author,

whose anatomical details are admirable, has failed to give a good general representation of the animal, from having had access only to spirit specimens. His generic and specific names are in consequence somewhat of misnomers, as the flattening of the surface, from the individuals falling from the centre in dying, gives more of a circular arrangement than really exists in nature. The change of colour has already been remarked upon.

The question arises, therefore, whether the *Diazona violacea* and *Syntethys hebridicus* are not one and the same animal. The only reason which induces us to keep them distinct is the peculiar [stout and obtuse] papillæ of the branchial sac (Pl. XLIX, fig. 6), so very different from the slender pointed ones represented by Savigny, and in which this careful observer could scarcely have been mistaken. Professor Goodsir has kindly supplied us with a portion of a specimen from the original habitat, and I believe now coincides in the view of its generic relation here taken. I am also indebted for specimens to Mr. McAndrew.

Its vitreous transparency, and the opaque white lines of the thorax, give this remarkable species very much the appearance of a huge group of *Clavelinæ* cemented together at the base.



INDEX

OF SPECIES, ETC., DESCRIBED IN VOL. II.

Synonyms in italics.

PAGE

Alcyonium ascidioides Pall. . 138
distomum Brug. . 138
Ascidia L. 1, 18, 35, 75, 97, 128, 139, 148, 155, 158
aggregata Rathk. . . 136
conchilega Müll. . . 41
? corrugata Müll. . . 10
echinata L. . . 93
gelatina Rathk. . . 152
grossularia Van. Ben. . 130
intestinalis L. . 9, ? 15
intestinalis (L.) Blainv. . 14
lepadiformis Müll. . 152
mamillaris Pall. . . 106
ocellata L.Ag. . . 11
opalina Macg. . . 26
parallelogramma Müll. . 25
pulchella Ald. . . 14
rustica jun. Müll. . 129, 132
sp. Schalck . . 11
villosa Dalyl. . . 145
virescens Penn. . . 11
virginia (Müll.) F. & H. . 26
viridescens Brug. . . 10
Ascidiadæ (*cont'd*) . . 1
Ascidium echinatum Woodw. . 94
Botryllus variolosus Chiaje . 138
Ciona (*Sav.*) *Flem.* . . 1
(*Ascidia*) *intestinalis* Flem. 11
fascicularis *Hanc.* . 15
intestinalis (*L.*) *Flem.* 9, 11
pulchella *Ald.* . . 14
Clavelina *Sav.* . . . 148
corrugata *sp. nov.* . 155
lepadiformis (*Müll.*) *Sav.* 152
producta *M. Edw.* . 154
Clavelinadæ . . . 147
Corella *A. & H.* . . 18
larvæformis *Hanc.* . 28

PAGE

Corella ovata *Hanc.* . . 31
parallelogramma (*Müll.*) *Hanc.* . . 25, 26
Cynthia *Sav.* 75, (as syn.) 97, 128
aggregata F. & H. . 136
ampulla F. & H. . . 120
claudicans *Sav.* . . 78
comata Ald. . . 120
coriacea A. & H. . . 109
echinata (*L.*) *Ald.* 93, 94
glacialis Ald. . . 122
glomerata Ald. . . 134
granulata Ald. . . 115
grossularia F. & H. . 130
humilis Ald. . . 116
informis Forb. . . 104
limacina *Forb.* . . 92
mamillaris Schmidt . 106
mora Dickie . . 86
moreus Cocks . . 86
morus *Forb.* . . 86
opalina Ald. . . 108
ovata *sp. nov.* . . 84
pomaria Sav. . . 110
quadrangularis Forb. . 105
rosea *Ald.* . . . 76
rustica F. & H. . . 130
squamulosa *Ald.* . . 81
sulcatula Ald. . . 113
tessellata *Forb.* . . 89
tuberosa Macg. . . 103
vestita Ald. . . 122
violacea Ald. . . 125
Cynthiadæ . . . 75
Cynthiæ Styelæ Sav. . . 97
Diazoma Lamk. . . 159
mediterranea Lamk. . 160
Diazona *Sav.* . . . 159
hebridica (*F. & G.*) *Ald.* . 160

	PAGE
Diazona mediterranea Risso	160
violacea Sav.	160
Distoma variolatus Blainv.	138
variolosum Sav.	138
Distomus Gaertn.	97
mamillaris Gaertn.	106
variolosus Gaertn.	138
Eugyra *A. & H.*	65
arenosa *A. & H.*	70
globosa *Hanc.*	73
Glandula Stimps.	76
Holothurium læve Vand.	9
Molgula *Forb.* 35, (as syn.)	65
arenosa A. & H.	70
citrina *A. & H.*	62
complanata *A. & H.*	45
conchilega (*Müll.*)	41
inconspicua *A. & H.*	59
ocelata Cocks	48
oculata *Forb.*	48
simplex *A. & H.*	51
siphonalis Sars	53
siphonata *Ald.*	53
socialis *Ald.*	56
tubularis Thomps.	70
tubulosa Forb.	70
valvata *sp. nov.*	49
Molgulidæ	34
? Pandocia Flem.	76
Pelonæa Woodw.	139
glabra Woodw.	146
Pelonaia *F. & G.*	139
? arenifera Stimps.	145
corrugata *F. & G.*	145
glabra *F. & G.*	146
lævis Bronn	147
rugosa Bronn	145
? villosa Sars	145
Perophora *Weigm.* 155,	158
Listeri *F. & H.*	158
Phallusia Sav. 18, 97,	128
intestinalis Sav.	10
mamillaris Lœw. & Koll.	107
rustica Flem.	130

	PAGE
Phallusia virginea (Müll.) Murr.	26
Phallusiæ Cionæ Sav.	1
Polyclinum diazona Cuv.	160
Polyzona variolosa Flem.	138
Sacanimal Dicq.	10
Stycla Menke	97
Styela (*Sav.*) *McLeay*	97
comata (*Ald.*)	120
coriacea *A. & H.*	109
depressa *sp. nov.*	126
fibrillata *sp. nov.*	125
granulata *Ald.*	115
humilis *sp. nov.*	116
informis (*Forb.*)	104
mamillaris (*Gaertn.*)	106
northumbrica *sp. nov.*	127
obscura *sp. nov.*	119
opalina (*Ald.*)	108
pomaria (*Sav.*)	110
quadrangularis (*Forb.*)	105
sulcatula (*Ald.*)	113
tuberosa (*Macg.*)	103
variabilis *sp. nov.*	117
vestita (*Ald.*)	122
violacea (*Ald.*)	125
Styelopsis *Traust.*	128
glomerata (*Ald.*)	134
grossularia (*Van Ben.*) *Traust.* 129,	130
lineata *sp. nov.*	133
sphærica *sp. nov.*	132
Syntethys F. & G.	159
hebridicus F. & G.	160
Tethyum fasciculatum Bohads.	15
? sociabile Gunn.	9
Thylacium *V. Carus*	135
aggregatum (*Rathk.*) *V. Carus.*	136
var. maculatum *v. nov.*	136
Normani *Ald.*	137
Sylvani *V. Carus*	137
variegatum Ald.	138
variolosum (*Gaertn.*)	138

PRINTED BY ADLARD AND SON, LONDON AND DORKING.

EXPLANATIONS OF THE PLATES.

EXPLANATION OF THE LETTERING.

a. Anus.
a. c. Alimentary canal.
at. Atrial aperture.
b. d. Biliary duct.
br. Branchial aperture.
en. Endostyle.
h. Heart.
l. Liver.
mo. Mouth.
od. Oviduct.
œ. Œsophagus.
r. Reproductive organs.
s. Stomach.
ts. Testis.
v. Ovary.
v. d. Vas deferens.

Plate 21

PLATE XXI.

FIGS.

1–5. *Ciona intestinalis* (Linn.) Flem. (p. 9) 1 and 2.—Test (1, fully expanded; 2, slightly contracted). 3.—Test of a young individual. 4.—Branchial aperture. 5.—Part of branchial sac : magnified.

6–8. *Ciona pulchella* Alder. (p. 14) 6.—A group of individuals with test extended. 7.—A single individual with test contracted. 8.—Mantle.

9. *Corella parallelogramma* (Müll.) Hanc. (p. 25) Test.

All the figures, except 5, natural size.

Plate 22

PLATE XXII.

FIGS.

1–8. *Ciona fascicularis* Hanc. (p. 15) 1.—A cluster: three-fifths natural size. 2.—Test, showing mantle within it: slightly enlarged. 3.—Test laid open, showing mantle more clearly: slightly enlarged. 4.—Mantle, with the test removed: slightly enlarged. *v.* "Ovary not developed." 5.—Mantle laid open, showing branchial sac, etc.: slightly enlarged. 6.—Atrial aperture of mantle, with siphon extended: three times natural size. 7.—Atrial aperture of mantle, with siphon retracted: three times natural size. 8.—Part of branchial sac with oral tentacles: magnified.

9. *Corella larvæformis* Hanc. (p. 28) Test, showing mantle within it: twice natural size.

10 and 11. *Corella ovata* Hanc. (p. 31) 10.—Test, showing mantle within it: twice natural size. 11.—Atrial aperture of mantle: magnified.

PLATE XXII.

Plate 23

PLATE XXIII.

Molgula conchilega (Müll.). (p. 41)

FIGS.

1–3. Views of mantle: one and a half times natural size. 1.—Right side. 2.—Left side. 3.—As seen from above. *v. t.* in fig. 2, blood-vessel from mantle to test.

4–6. Mantle laid open: about twice natural size. 4.—Showing external surface of branchial sac, etc. ♂ *ch.* male channels. 5.—Showing internal surface, etc. *r. v.* right ovary; *l. v.* left ovary. 6.—With outer membrane of branchial sac turned back, showing interior.

Plate 24

PLATE XXIV.

FIGS.

1–6. *Molgula complanata* A. & H. (p. 45) 1 and 2.—Views of mantle, the test removed from the surface seen, but showing along the margin: six times natural size. In fig. 2, *x* is some foreign body inside the mantle. 3 and 4.—Mantle laid open, exposing (in 3) digestive and reproductive organs, and (in 4) branchial sac: about eight times natural size. 5.—Liver: magnified. 6.—Larva: magnified.

7–10. *Molgula oculata* Forbes. (p. 48) 7 and 8.—Views of mantle (7, left side; 8, right side): about two-thirds natural size. 9 and 10.—Mantle laid open, exposing (in 9) digestive and reproductive organs, and (in 10) branchial sac.

Plate 25

PLATE XXV.

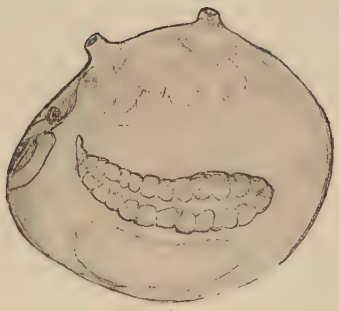
Figs.

1. *Molgula valvata* sp. nov. (p. 49) Mantle, showing alimentary canal: four times natural size.

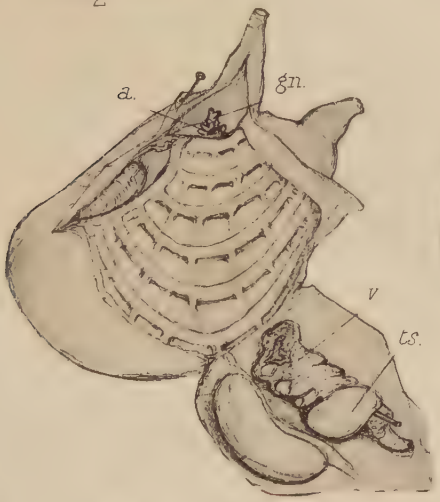
2 and 3. *Molgula simplex* A. & H. (p. 51) Mantle: three times natural size. 2.—Right side, showing digestive organs. 3.—Left side, showing reproductive organs.

4–6. *Molgula siphonata* Alder. (p. 63) 4 and 5.—Mantle, showing digestive and reproductive organs (4, left side; 5, right side): one and a half natural size. 6.—Mantle laid open, exposing branchial sac, etc.: a little more enlarged. *gn.* genital outlet.

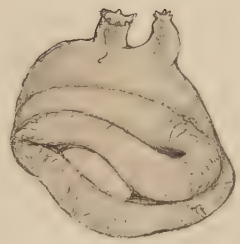
2



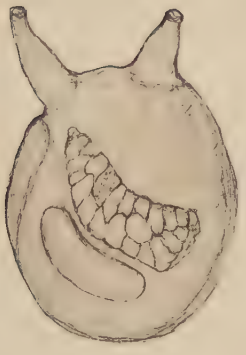
3



6



1



4

5

Plate 26

PLATE XXVI.

Figs.

1–4. *Molgula siphonata* Alder. (p. 53) 1.—Test: natural size. 2.—Mantle: natural size. 3.—Branchial aperture: three times natural size. 4.—Part of branchial sac: magnified.

5–9. *Molgula citrina* A. & H. (p. 62) 5–7.—Views of test: twice natural size. 8.—Part of branchial sac: magnified. 9.—Larva: magnified.

10 12. *Eugyra arenosa* A. & H. (p. 70) 10.—Test: natural size. 11 and 12.—Views of mantle (11, right side; 12, left side): natural size.

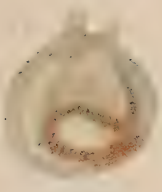


Plate 27

PLATE XXVII.

FIGS.

1 and 2. *Molgula socialis* Alder. (p. 56) Views of mantle: three times natural size. 1.—Right side, showing digestive organs. 2.—Left side, showing reproductive organs, etc.

3–5. *Molgula inconspicua* A. & H. (p. 59) 3 and 4.—Views of mantle (3, right side; 4, left side): six times natural size. *rc.* rectum. 5.—Mantle laid open, showing digestive and reproductive organs: about eight times natural size.

6–8. *Molgula citrina* A. & H. (p. 62) 6 and 7.—Views of mantle (6, right side; 7, left side): three and a half times natural size. 8a–d.—Larva, in different stages of growth: magnified.

Plate 28

PLATE XXVIII.

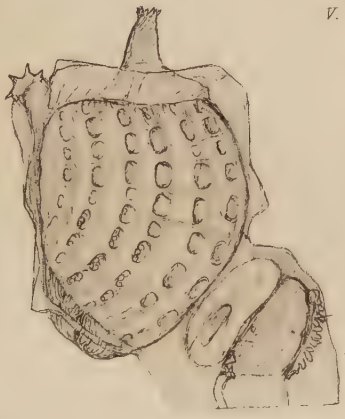
FIGS.

1 and 2. *Molgula socialis* Alder. (p. 56) Test and mantle laid open : three times natural size. 1.—Showing outer surface of branchial sac, etc. 2.—Showing inner surface, etc.

3–5. *Molgula citrina* A. & H. (p. 62) Test and mantle laid open : twice natural size. 3.—Showing outer surface of branchial sac, etc. 4.—Showing inner surface. 5.—Showing digestive and reproductive organs.

1

2



3

4

5

Plate 29

PLATE XXIX.

FIGS.

1–4. *Eugyra arenosa* A. & H. (p. 70) 1.—Mantle. 2.—Mantle partly laid open, exposing external surface of branchial sac. 3.—Mantle fully laid open, and outer layer of branchial sac removed, exposing the interior. 4.—Branchial sac removed, exposing digestive organs, etc.

5–7. *Eugyra globosa* Hanc. (p. 73) 5.—Test. 6 and 7.—Views of mantle (6, right side; 7, left side).

All the figures about twice natural size.

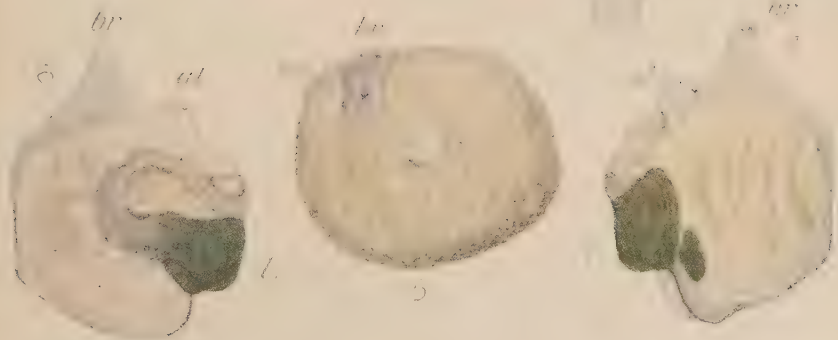


Plate 30

PLATE XXX.

Figs.

1 and 2. *Cynthia claudicans* Sav. (p. 78) 1.—Test: natural size. 2.—Branchial siphon and aperture: twice natural size.

3. *Cynthia squamulosa* Alder. (p. 81) Test: natural size.

4 and 5. *Cynthia ovata* sp. nov. (p. 84) 4.—Test, to show position only, adhering to shell: two-thirds natural size. 5.—Test: one and a third natural size.

6 and 7. *Cynthia morus* Forbes. (p. 86) 6.—Test: natural size. 7.—Mantle: natural size.

8 and 9. *Cynthia tessellata* Forbes. (p. 89) 8.—Test: twice natural size. 9.—Portion of test, showing form of tessellations: a little further enlarged.

10. *Cynthia echinata* (Linn.) Alder. (p. 93) Test: one and a third natural size.

Plate 31

PLATE XXXI.

FIGS.

1 and 2. *Cynthia rosea* Alder. (p. 76) 1.—Test and mantle laid open, exposing branchial sac. 2.—Branchial sac removed, exposing digestive and reproductive organs. Both figures about one and a half natural size.

3–5. *Cynthia claudicans* Sav. (p. 78) 3.—Test and mantle laid open, exposing branchial sac. 4.—Branchial sac removed, exposing digestive and reproductive organs. Both figures about twice natural size. 5.—Upper end of endostyle: much more enlarged.

6–8. *Cynthia squamulosa* Alder. (p. 81) 6.—Test and mantle laid open, exposing branchial sac. 7.—Branchial sac removed, exposing digestive and reproductive organs. Both figures about three times natural size. 8.—A cluster of ovaries: much more enlarged.

Plate 32

PLATE XXXII.

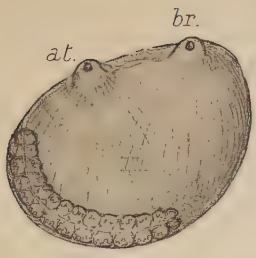
Figs.

1 and 2. *Cynthia squamulosa* Alder. (p. 81) Mantle: two and a half times natural size. 1.—Left side, showing muscular fibres on the surface and reproductive organs within. 2.—Right side, showing alimentary canal and reproductive organs.

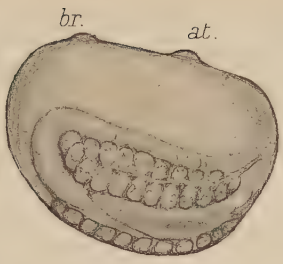
3–5. *Cynthia ovata* sp. nov. (p. 84) Mantle: two and a half times natural size. 3.—Right side, showing muscular fibres. 4.—Right side, showing digestive and reproductive organs. 5.—Left side, showing the same.

6 and 7. *Cynthia tessellata* Forbes. (p. 89) Mantle: three times natural size. 6.—As seen from above, showing muscular fibres, strongly marked at *ms.* 7.—Right side, showing (indistinctly) digestive and reproductive organs. *a. e.* anal extremity; *o. e.* oral extremity. *i.* intestine.

8. *Cynthia echinata* (Linn.) Alder. (p. 93) Mantle, left side: two and a half times natural size.

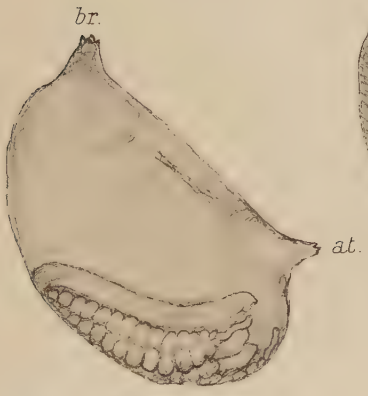


1

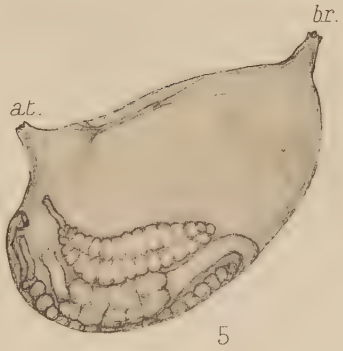


2

3

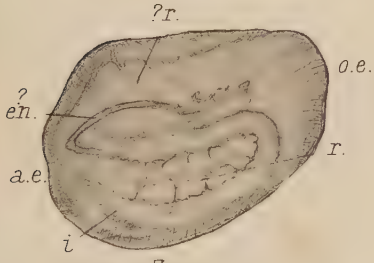


4

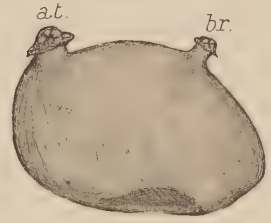


5

6



7



8

Plate 33

PLATE XXXIII.

FIGS.

1. *Cynthia ovata* sp. nov. (p. 84) Mantle laid open, exposing branchial sac and portions of the digestive and reproductive organs : about twice natural size.

2–5. *Cynthia morus* Forbes. (p. 86) 2.—Mantle laid open, exposing branchial sac. *fr.* "fringe formed by the projecting ends of the longitudinal rods." 3.—Branchial sac removed, exposing digestive and reproductive organs. *br. s.* "cut end of branchial sac." *r. d.* "reproductive ducts." Both figures about twice natural size. 4.—A cluster of nodules composing the reproductive organs: much enlarged. 5.—A few of these nodules further enlarged. *v. d.* "branch of vas deferens."

6 and 7. *Cynthia tessellata* Forbes. (p. 89) 6.—Mantle laid open, exposing branchial sac. *mo.* "mouth separated from the œsophagus." 7.—Branchial sac turned over, exposing digestive and reproductive organs. *nod.* "angular nodules." Both figures about twice natural size.

Plate 34

PLATE XXXIV.

FIGS.

1–5. *Styela tuberosa* (Macg.). (p. 102) 1.—Test: natural size. 2.—Branchial aperture: twice natural size. 3.—Mantle: natural size. 4.—Branchial sac: twice natural size. 5.—A young individual: natural size.

6. *Styela informis* (Forbes). (p. 104) Test: natural size.

7 and 8. *Styela mamillaris* (Gaertn.). (p. 106) 7.—Test: natural size. 8.—Mantle: natural size.

Plate 35

PLATE XXXV.

FIG.

1. *Styela tuberosa* (Macg.). (p. 102)
2. *Styela mamillaris* (Gaertn.). (p. 106)

Each figure represents the test laid open, exposing the mantle, and showing, at the base, the blood-vessel leading from the mantle to the test; and each is one and a half natural size.

Plate 36

PLATE XXXVI.

FIGS.

1–7. *Styela tuberosa* (Macg.). (p. 102) 1–3.—Test and mantle laid open, exposing (in fig. 1) branchial sac, (in fig. 2) branchial sac and reproductive organs, and (in fig. 3) digestive and reproductive organs, the branchial sac being removed. 4–7.—Reproductive organs, various views: magnified.

8 and 9. *Styela informis* (Forbes). (p. 104) 8.—Test and mantle removed, exposing branchial sac. 9.—Branchial sac removed, exposing digestive and reproductive organs. Both figures natural size.

Plate 37

PLATE XXXVII.

FIGS.

1–4. *Styela coriacea* A. & H. (p. 109) 1.—A young individual, extended: natural size. 2.—An adult, extended: natural size. 3.—The same, contracted: natural size. 4.—Tubercles of the test: slightly enlarged.

5. *Styela pomaria* (Sav.). (p. 110) Test: natural size.

6 and 7. *Styela sulcatula* (Alder). (p. 113) 6.—Tests, extended: natural size. 7.—Test, contracted: natural size.

8 and 9. *Styela granulata* (Alder). (p. 115) 8.—Three individuals; fully extended, partly extended, and contracted: natural size. 9.—Facets of the test: magnified.

10–12. *Styela variabilis* sp. nov. (p. 117) 10.—The usual form: natural size. 11.—A variety: natural size. 12.—Mantle: slightly enlarged.

13. (*?*) *Styela obscura* sp. nov. (p. 119) Test: natural size.

14. *Styela comata* (Alder). (p. 120) Test: natural size.

15. *Styela vestita* (Alder). (p. 122) Test, with the siphons extended: natural size.

16 and 17. *Styela violacea* (Alder). (p. 125) 16.—Test, with the siphons retracted: two and a half times natural size. 17.—The same, with the siphons extended: two and a half times natural size. 16a represents the natural size.

18. *Styela fibrillata* sp. nov. (p. 125) Test of an ovate form: natural size.

Plate 38

PLATE XXXVIII.

Styela fibrillata sp. nov. (p. 125)

FIG.

1. Test of a sub-orbicular form: natural size.
2. Fibrils of the test, some with particles of sand attached: magnified.
3. Fibrils of a different character: more highly magnified.

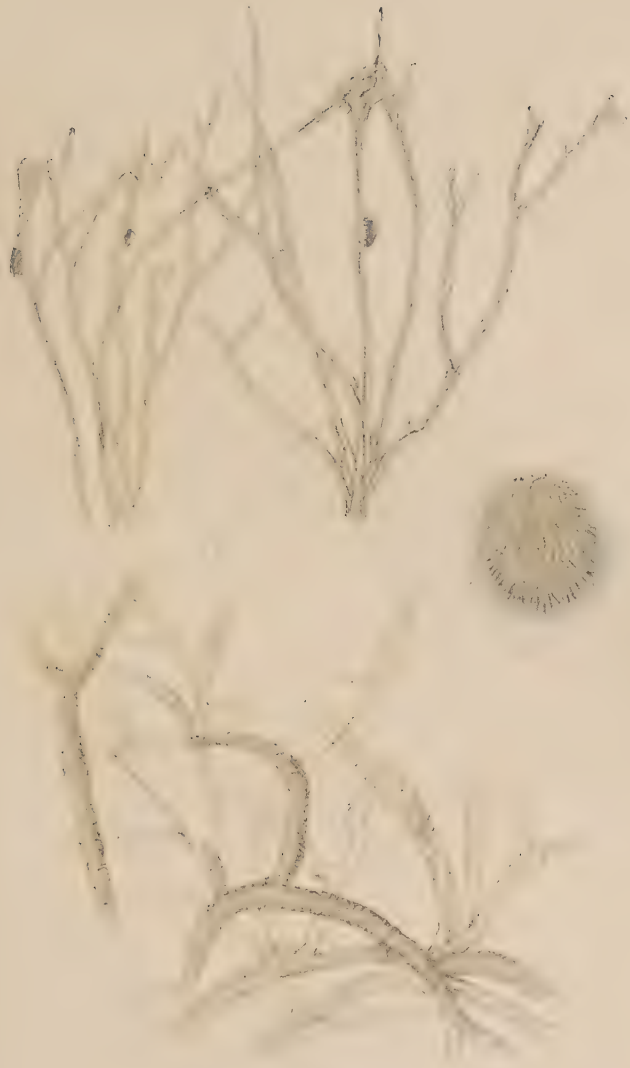


Plate 39

PLATE XXXIX.

Figs.

1. A *Styela*, undescribed. Mantle: six times natural size.

2 and 3. *Styela coriacea* A. & H. (p. 109) Views of mantle: twice natural size. 2.—Left side. 3.—Under side (?).

4. *Styela pomaria* (Sav.). (p. 110) Mantle, left side: three times natural size.

5 and 6. *Styela granulata* (Alder). (p. 115) Mantle: four times natural size. 5.—Right side. 6.—Left side.

7. *Styela humilis* sp. nov. (p. 116) Test: one and a half natural size.

8. *Styela comata* (Alder). (p. 120) Mantle: one and a half natural size.

9. *Styela vestita* (Alder). (p. 125) Mantle: twice natural size.

10–12. *Styela violacea* (Alder). (p. 125) Views of mantle: four times natural size. 10.—As seen from above. 11.—Left side. 12.—As seen from below.

13–16. *Styela depressa* sp. nov. (p. 126) 13.—Test, as seen from above, with the siphons retracted: three times natural size. 14.—Portion of test, with the siphons extended: further enlarged. 15 and 16.—Views of mantle: five times natural size (15, right side; 16, left side).

17. *Styela northumbrica* sp. nov. (p. 127) Test, investing portion of shell of *Modiola vulgaris*: one and a half natural size.

Plate 40

PLATE XL.

FIG.

1. Branchial tentacle of *Molgula siphonata* Alder. (p. 55)
2. Fibrils of the same species, one with a particle of sand attached. (p. 55)
3. Fibrils of another species of *Molgula*, possibly *M. valvata* sp. nov. (see p. 51)
4. Branchial tentacle of *Molgula citrina* A. & H. (p. 63)
5. Fibrils of *Eugyra arenosa* A. & H. (p. 70)
6. Branchial tentacle of *Cynthia claudicans* Sav. (p. 80)
7. Pinnate branchial tentacle of *Cynthia squamulosa* Alder. (p. 83) (A bi-pinnate tentacle is represented by fig. 33 in the text.)
8. Oral lamina, consisting of tentacular processes; and branchial tubercle; of *Cynthia morus* Forbes. (p. 88)
9. Fibrils of *Styela fibrillata* sp. nov. (p. 125)

The organs are described on the pages referred to. The figures are magnified in various proportions.

Plate 41

PLATE XLI.

FIGS.

1–3. *Styela mamillaris* (Gaertn.). (p. 106) Test and mantle laid open: about twice natural size. 1.—Exposing outer surface of branchial sac. 2.—Branchial sac partly removed, exposing its inner surface, also anus, reproductive organs, etc. 3.—Branchial sac wholly removed, exposing digestive and reproductive organs.

4 and 5. *Styela coriacea* A. & H. (p. 109) Test and mantle laid open: about twice natural size. 4.—Exposing branchial sac. 5.—Branchial sac removed, exposing digestive and reproductive organs. *v. h.* "vessel from heart."

Plate 42

PLATE XLII.

FIGS.

1–7. *Styela pomaria* (Sav.). (p. 110) 1 and 2.—Test and mantle removed, exposing (in fig. 1) branchial sac, and (in fig. 2) digestive and reproductive organs, the branchial sac being removed: about twice natural size. 3–7.—Ovaries, various views: magnified.

8 and 9. *Styela sulcatula* (Alder). (p. 113) Test and mantle removed: about twice natural size. 8.—Exposing branchial sac. 9.—Branchial sac removed, exposing digestive and reproductive organs. *b. l.* biliary lobe.

10 and 11. *Styela granulata* (Alder). (p. 115) 10.—Test and mantle removed, exposing branchial sac: about three times natural size. 11.—Exposing digestive and reproductive organs, the branchial sac being removed.

v.d

Plate 43

PLATE XLIII.

FIGS.

1. *Styela variabilis* sp. nov. (p. 117) Animal laid open, showing digestive and reproductive organs.

2 and 3. *Styela comata* (Alder). (p. 120) 2.—Test and mantle removed, exposing branchial sac, with reproductive organs showing through it. 3.—Branchial sac removed, exposing digestive and reproductive organs clearly.

4 and 5. *Styela vestita* (Alder). (p. 122) 4.—Test and mantle laid open, exposing branchial sac, with digestive and reproductive organs showing through it. 5.—Branchial sac removed, showing digestive and reproductive organs more clearly.

All the figures about twice natural size.

Plate 44

PLATE XLIV.

Figs.

1–3. *Styela fibrillata* sp. nov. (p. 125) 1.—Test removed and mantle laid open, exposing outer surface of branchial sac. 2.—Branchial sac partly removed, showing its inner surface, and exposing digestive and reproductive organs. 3.—Branchial sac wholly removed, showing digestive and reproductive organs more clearly. About twice natural size.

4 and 5. *Styela depressa* sp. nov. (p. 126) 4.—Test and mantle laid open, exposing branchial sac. 5.—Branchial sac removed, exposing digestive and reproductive organs. About three times natural size.

6. *Styela northumbrica* sp. nov. (p. 127) Test removed, mantle laid open, and branchial sac removed, exposing digestive and reproductive organs. About four times natural size.

Plate 45

PLATE XLV.

FIGS.

1. *Styelopsis glomerata* (Alder). (p. 134) A cluster: natural size.
2. Probably the same species: (?) slightly enlarged.*
3–5. *Thylacium Normani* (Alder). (p. 138) 3.—A cluster: natural size. 4.—Part of the same: twice natural size. 5.—A single individual: four times natural size.†

* Alder may have made this drawing from a cluster now in the Norman Collection in the British Museum, labelled "*Cynthia glomerata* (Ald.), Gouliot Caves, Sark," a locality not given for the species in the author's MS. On an older label is written "(? *glomerata*)." The cluster, Canon Norman states, was collected not earlier than 1854 nor later than 1865. It is now much broken up.

† The specimen from which Alder made these drawings is in the same collection, and is still perfect.

Plate 46

PLATE XLVI.

FIGS.

1–4. *Styelopsis grossularia* (Van Ben.) Traust. (p. 129) 1.—A group: natural size. 2.—A single individual from this group: twice natural size. 3.—An individual, probably a variety of this species, with a young one attached: three times natural size. 4.—The same: natural size.

5. *Styelopsis glomerata* (Alder). (p. 134) A cluster: natural size.

6–8. *Thylacium aggregatum* (Rathke) V. Carus. (p. 136) 6.—A group: one-half natural size. 7.—A single individual: natural size. 8.—A group, probably a variety of this species, of the size and form of var. *maculatum*, but apparently not spotted: natural size.

9–11. *Thylacium Sylvani* V. Carus. (p. 137) 9.—A group of small ones. 10.—A group of rather larger ones. 11.—A single individual, much larger. All with young ones attached; and natural size.

12–14. *Thylacium variolosum* (Gaertn.). (p. 138) 12.—A mass: twice natural size. 13.—Showing mode of growth on an Ascidian (?): natural size. 14.—A larva: magnified.

15 and 16. *Pelonaia corrugata* Forb. & Goods. (p. 145) 15.—Test: natural size. 16.—Part of branchial sac: magnified.

Plate 47

PLATE XLVII.

Pelonaia corrugata Forb. & Goods. (p. 146)

FIGS.

1–3. Test and mantle laid open, exposing (in fig. 1) digestive and reproductive organs fully, the branchial sac being removed; (in fig. 2) the inside of the branchial sac, the outer layer being laid open and partly removed, with the endostyle showing clearly in the centre, and the digestive and reproductive organs partially; and (in fig. 3) the external surface of the branchial sac, the digestive and reproductive organs partially, and part of the surface of the test with fibrils: about three times natural size.* *br. s.* branchial sac.

4. The anterior end of fig. 2, showing apertures, tentacles, branchial tubercle (*b. t.*) with nerve-ganglion (*n. g.*), oral lamina (*o. l.*), and endostyle: about six times natural size.

5. The anterior end of fig. 1 or 3, showing the apertures: about three times natural size.

6 and 7. Ovaries: about twelve times natural size. 6b is a continuation at x of 6a. 7 shows the same part as 6b in a more advanced stage of development.

* Figs. 1 and 3 terminate abruptly, without showing the apertures, owing to the original drawings coming to the edge of the paper on which they are drawn. (All Hancock's drawings are on half sheets of note-paper.)

Plate 48

PLATE XLVIII.

The Branchial Tubercle.

Fig.

1. *Molgula conchilega* Müll. (p. 38)
2. *M. socialis* Alder. (p. 58)
3. *M. citrina* A. & H. (p. 63)
4. *Cynthia claudicans* Sav. (p. 80)
5. *C. squamulosa* Alder. (p. 83)
6. *C. morus* Forbes. (p. 88)
7. *C. tessellata* Forbes. (p. 91)
8. *C. echinata* (Linn.) Alder. (p. 96)
9. *Styela tuberosa* (Macg.). (p. 99)
10. *S. pomaria* (Sav.). (p. 111)
11. *S. sulcatula* (Alder). (p. 114)
12. *S. granulata* (Alder).
13. *S. humilis* sp. nov. (p. 117)
14. *S. variabilis* sp. nov.
15. *S. obscura* sp. nov.
16. *S. comata* (Alder).
17. *S. vestita* (Alder).
18. *Pelonaia corrugata* Forb. & Goods. (p. 141)

The tubercles are described on the pages referred to. The figures are magnified in various proportions.

Plate 49

PLATE XLIX.

Figs.

1 and 2. *Clavelina lepadiformis* (Müll.) Sav. (p. 152) 1.—A cluster: twice natural size. 2.—Part of branchial sac: magnified.

3. *Clavelina corrugata* sp. nov. (p. 155) Two individuals: twice natural size.

4–6. *Diazona hebridica* Forb. & Goods. (*violacea* Sav.). (p. 160) 4.—A "common mass:" two-thirds natural size. 5.—A single individual: one and a quarter natural size. 6.—Part of branchial sac: magnified.

1

2

3

5

6

4

Plate 50

PLATE L.

Clavelina lepadiformis (Müll.) Sav. (p. 152)

FIGS.

1. Test, showing through it the branchial sac in the thorax and the digestive and reproductive organs in the abdomen. *x*. "A free space between the mouth and viscera; else, where the œsophagus, stomach, and intestine appear to be adherent to the common envelope" (*Hancock*, remark written on drawing). A thickening of the mantle (*Milne Edwards*).

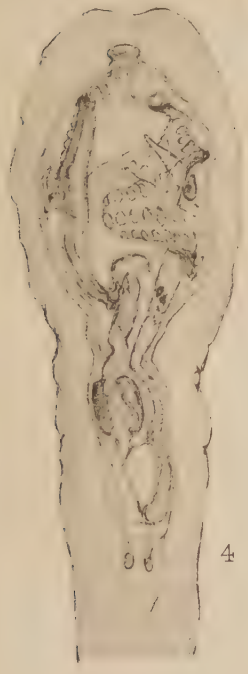
2 and 3. Right and left sides of two specimens deprived of their test, with the branchial sac shrunk up.

4 and 5. Right side of two specimens with the mantle shrunk up within the test, and the branchial sac much shrunk up (probably from immersion in spirit). In fig. 5 the upper *h* should be *i* (intestine), the lower *h* only indicating the heart.

2

3

x
1


4

h.
5
h.

RAY SOCIETY

INSTITUTED 1844

FOR THE PUBLICATION OF WORKS ON

NATURAL HISTORY

ANNUAL SUBSCRIPTION ONE GUINEA

LIST OF THE SOCIETY

FOR THE YEAR 1906

WITH A

LIST OF THE PUBLICATIONS

1844–1905

CORRECTED TO 15TH NOVEMBER, 1906

OFFICERS AND COUNCIL.

1906—1907.

President.

THE RT. HON. LORD AVEBURY, D.C.L., LL.D., PRES.SOC.ANT., FOR.SEC.R.A., F.R.S., F.L.S., ETC.

Vice-Presidents.

REV. CANON NORMAN, M.A., D.C.L., LL.D., F.R.S.
ALBERT D. MICHAEL, F.L.S., F.Z.S.
PROF. W. C. McINTOSH, M.D., LL.D., F.R.S.L.&E.

Council.

ROBERT BRAITHWAITE, M.D., F.L.S.
T. A. CHAPMAN, M.D., F.Z.S.
Rev. ALFRED FULLER, M.A., F.E.S.
A. E. GIBBS, F.L.S., F.R.H.S.
JOHN HARLEY, M.D.
Prof. W. A. HERDMAN, D.Sc., F.R.S., F.R.S.E., Pres.L.S.
B. DAYDON JACKSON, F.L.S.
ALBERT H. JONES, F.E.S.
J. W. S. MEIKLEJOHN, M.D., F.L.S.
J. S. PHENÉ, LL.D., F.S.A.
Prof. EDWARD B. POULTON, M.A., Sc.D., LL.D., F.R.S.
HENRY POWER, M.B., F.L.S., F.Z.S.
P. H. PYE-SMITH, M.D., B.A., F.R.C.P., F.R.S.
R. F. SCHARFF, Ph.D., B.Sc., F.L.S., F.Z.S.
D. H. SCOTT, M.A., Ph.D., F.R.S., F.L.S., Pres.R.M.S.
RT. HON. LORD WALSINGHAM, M.A., LL.D., F.R.S., F.L.S.

Treasurer.

F. DUCANE GODMAN, D.C.L., F.R.S., F.L.S., F.G.S., F.Z.S.

Secretary.

JOHN HOPKINSON, F.L.S., F.G.S., F.R.Met.Soc., Assoc.Inst.C.E., Weetwood, Watford.

LIST OF THE RAY SOCIETY.

Aberdeen University Library; *King's College, Aberdeen.*
Adelaide Public Library; *Adelaide, S. Australia.*
Adkin, Robert, F.E.S.; *Wellfield, 4 Lingards Road, Lewisham,* S.E.
Adlard, R. E.; *Bartholomew Close,* E.C.
Advocates' Library; *Edinburgh.*
Albany Museum; *Grahamstown, Cape Colony, S. Africa.*
Armstrong College; *Newcastle-upon-Tyne.*
Army and Navy Club; 36 *Pall Mall,* S.W.
Ash, The Rev. Cyril D.; *Saxton Vicarage, Tadcaster.*
Athenæum Club; *Pall Mall,* S.W.
Australian Museum; *Sydney, New South Wales.*
Avebury, The Right Hon. Lord, D.C.L., LL.D., F.R.S., F.S.A., F.L.S., F.G.S., F.Z.S., F.E.S., PRESIDENT; 15 *Lombard Street,* E.C.; 6 *St. James's Square,* S.W.; *and High Elms, Farnborough,* R.S.O., *Kent.*

Baer, Joseph, & Co.; 6 *Hochstrasse, Frankfort, Germany.*
Bainbridge, Miss M. E.; 9 *Churchfield Road, Ealing,* W.
Barrow-in-Furness Public Library; *Barrow-in-Furness.*
Battersea Public Library; *Lavender Hill,* S.W.
Belfast Library; *Donegal Square, Belfast.*
Bentley, Richard, F.S.A., F.L.S., Pres.R.Met.Soc., F.R.G.S.; *The Mere, Upton, Slough.*
Berens, A. A., M.A.; *Castlemead, Windsor.*
Bergens Museums Bibliotek; *Bergen, Norway.*
Berlin Royal Library; *Berlin.*
Berlin Royal Zoological Museum; *Berlin.*
Berne Natural History Museum; *Berne, Switzerland.*
Bethune-Baker, George T., F.L.S., F.E.S.; 19 *Clarendon Road, Edgbaston, Birmingham.*
Bibliothèque Nationale; *Paris.*

Binks, Mrs. I.; 9 *Burton Street, Wakefield.*

Birmingham Free Libraries; *Birmingham.*

Blackburne-Maze, W. P., F.E.S.; *Shaw House, Newbury.*

Bloomfield, The Rev. E. N., M.A., F.E.S.; *Guestling Rectory, Hastings.*

Board of Education, Secondary Branch; *South Kensington,* S.W.

Bodleian Library; *Oxford.*

Bootle Free Library; *Oriel Road, Bootle, Liverpool.*

Bostock, E. D., F.E.S.; *Holly House, Stone.*

Boston Public Library; *Boston, Mass., U.S.A.*

Boston Society of Natural History; *Berkeley Street, Boston, Mass., U.S.A.*

Bourne, T. W.; *Rock Cottage, Newton Abbot.*

Bowles, Edward Augustus; *Myddelton House, Waltham Cross.*

Bradford Natural History and Microscopical Society; *Church Institute, North Parade, Bradford.*

Brady, G. Stewardson, M.D., LL.D., F.R.S.; *Park Hurst, Endcliffe, Sheffield.*

Braithwaite, Robert, M.D., M.R.C.S.E., F.L.S.; 26 *Endymion Road, Brixton Hill,* S.W.

Breslau University Library; *Breslau, Germany.*

Briggs, C. A., F.E.S.; *Rock House, Lynmouth,* R.S.O., *North Devon.*

Briggs, T. H., M.A., F.E.S.; *Rock House, Lynmouth,* R.S.O., *North Devon.*

Brighton and Hove Natural History Society; *Public Library, Brighton.*

Bristol Municipal Public Libraries; *Bristol.*

Bristol Museum; *Queen's Road, Bristol.*

Bristol Naturalists' Society; 20 *Berkeley Square, Bristol.*

British Museum; *Bloomsbury,* W.C.

Brockholes, Mrs. J. Fitzherbert; *Clifton Hill, Garstang,* R.S.O., *Lancashire.*

Brokenshire, Fred. R.; 7 *Hillsboro' Avenue, Pennsylvania, Exeter.*

Bromley Naturalists' Society; 92 *London Road, Bromley, Kent.*

Brussels National Library; *Brussels.*

Buchan-Hepburn, Sir Archibald, Bart., F.E.S.; *Smeaton-Hepburn, Prestonkirk, N.B.*

Burrows, The Rev. C. R. N.; *Mucking Vicarage, Stanford-le-Hope,* s.o., *Essex.*

Butterfield, W. Ruskin; *The Museum, Hastings.*

Cambridge Philosophical Library; *New Museums, Cambridge.*

Cambridge University Library; *Cambridge.*

Campbell, F. Maule, F.L.S., F.Z.S., F.E.S., F.R.M.S.; *Brynllwydwyn, Machynlleth.*

Canterbury, Philosophical Institution of; *Christchurch, New Zealand.*

Cardiff Free Libraries; *Cardiff.*

Carlyon, T. A.; *Connemara, Darracott Road, Boscombe Park, Bournemouth.*

Chapman, Edward, M.A., F.L.S.; *Hill End, Mottram, Manchester.*

Chapman, T. Algernon, M.D., F.Z.S., F.E.S.; *Betula, Reigate.*

Cheltenham Natural Science Society; *Cheltenham.*

Chester Society of Natural Science; *Grosvenor Museum, Chester.*

Chicago Public Library; *Chicago, Ill., U.S.A.*

Chicago University Library; *Chicago, Ill., U.S.A.*

Christiania, University of; *Christiania, Norway.*

Church, Sir W. S., Bart., M.D.; 130 *Harley Street,* W.

Clark, J. A., L.D.S., F.E.S.; 57 *Weston Park, Crouch End,* N.

Cleland, John, M.D., D.Sc., LL.D., F.R.S., Professor of Anatomy, University of Glasgow; 2 *The University, Glasgow.*

Congress, Library of; *Washington, D.C., U.S.A.*

Cornell University Library; *Ithaca, New York, U.S.A.*

Cornwall, Royal Institution of; *Truro.*

Cotton, John, M.R.C.S., F.E.S.; *Simonswood, Prescot Road, St. Helens.*

Crawford, W. C.; 1 *Lockerton Gardens, Colinton Road, Edinburgh.*

Crawshay, Lionel Routledge, M.A.(Oxon); *Marine Biological Laboratory, Plymouth.*

Croft, R. Benyon, R.N.; *Fanhams Hall, Ware.*

Croydon Public Libraries; *Town Hall, Croydon.*

Dames, Felix L.; 12 *Landgrafenstrasse, Berlin,* W. 62.

Davies, A. Ellson, Ph.D., F.L.S., F.C.S.; *Tweedbank, West Savile Road, Edinburgh.*

Derby Free Library and Museum; *Wardwick, Derby.*

Detroit Public Library; *Detroit, Mich., U.S.A.*

Devonshire, His Grace the Duke of, K.G., M.A., LL.D., F.R.S., Hon.M.Inst.C.E.; *Devonshire House, Piccadilly,* W., *and Chatsworth, Derbyshire.*

Dickinson, William; *Warham Road, Croydon.*

Downing College; *Cambridge.*

Dublin, Royal, Society; *Leinster House, Dublin.*

East Kent Natural History Society; *Medical Hall, Canterbury.*

Eastwood, John E., F.E.S.; *Enton Lodge, Witley, Godalming.*

Edinburgh Public Library; *Edinburgh.*

Edinburgh, Royal Society of; *Edinburgh.*

Edinburgh University Library; *Edinburgh.*

Eliot, Sir Charles, LL.D., K.C.M.G., C.B., F.Z.S., F.R.G.S.; *Endcliffe Holt, Endcliffe Crescent, Sheffield.*

Elphinstone, Sir Howard W., Bart., M.A., F.L.S., F.R.G.S.; 2 *Stone Buildings, Lincoln's Inn,* W.C., *and Struan, Wimbledon Park,* S.W.

England, Royal College of Surgeons of; *Lincoln's Inn Fields,* W.C.

Fielding, Clement, M.P.S.; *Clover Hill, Halifax.*

FitzGerald, The Rev. H. Purefoy, F.L.S., F.C.S.; *Barracane, Wellington College,* S.O., *Berks.*

Fletcher, W. H. B., M.A., F.E.S.; *Aldwick Manor, Bognor.*

Folkestone Free Public Library and Museum; *Folkestone.*

Foster, C.; *Thorpe, Norwich.*

France, Institut de; *Paris.*

Fraser, F. J.; 19 *Southampton Street, Bloomsbury,* W.C.

Freeman, Francis F., F.E.S.; *Abbotsfield, Tavistock.*

Friedländer & Sohn; 11 *Carlstrasse, Berlin,* N.W. 6.

Fulham Public Libraries (Central Library); 598 *Fulham Road,* S.W.

Fuller, The Rev. Alfred, M.A., F.E.S.; *The Lodge, Sydenham Hill,* S.E.

Gannett, Frank W.; *Dalegarth, Windermere.*

Gascoigne, Major French; *Lotherton Hall, Aberford, Leeds.*

Geological Society of London; *Burlington House, Piccadilly, W.*

Gerold & Co.; *Vienna.*

Gibbs, Arthur Ernest, F.L.S., F.R.H.S., Hon. Sec. Herts Nat. Hist. Soc.; *Kitchener's Meads, St. Albans.*

Gibson, Miss; *Hill House, Saffron Walden.*

Giles, Harry M.; *Zoological Gardens, South Perth, Western Australia.*

Glasgow Natural History Society; 207 *Bath Street, Glasgow.*

Glasgow, Royal Philosophical Society of; 137 *West George Street, Glasgow.*

Glasgow University Library; *Glasgow.*

Godman, F. DuCane, D.C.L., F.R.S., F.L.S., F.G.S., F.Z.S., F.E.S., F.R.H.S., Treasurer; 45 *Pont Street, Belgrave Square, S.W., and South Lodge, Horsham.*

Göttingen University Library; *Göttingen, Germany.*

Great Britain, Pharmaceutical Society of; 17 *Bloomsbury Square, W.C.*

Green, E. Ernest, F.E.S., Government Entomologist; *Royal Botanic Gardens, Peradeniya, Ceylon.*

Grosvenor Public Library; *Buffalo, N.Y., U.S.A.*

Guille-Allès Library; *Guernsey.*

Haileybury College; *Hertford.*

Halifax Public Library; *Belle View, Halifax.*

Hardy, Alfred Douglas, F.L.S., F.R.M.S.; *Lands Department, Melbourne, Victoria, Australia.*

Harley, John, M.D., F.R.C.P., F.L.S.; *Beedings, Pulborough,* R.S.O., *Sussex.*

Harmer, Sidney F., Sc.D., F.R.S.; *King's College, Cambridge.*

Harrison, Albert, F.L.S., F.E.S., F.R.M.S., F.C.S.; *Delamere, Grove Road, South Woodford.*

Harvard Museum of Comparative Zoology; *Cambridge, Mass., U.S.A.*

Heidelberg University Library; *Heidelberg, Germany.*

Hertfordshire County Museum; *St. Albans.*

Hertfordshire Natural History Society and Field Club; *Upton House, Watford.*

Hewitt, David Basil, F.R.C.S.I.; *Oakleigh, Northwich.*

Hilton, James; 60 *Montague Square,* W.

Hood, Donald W. C., M.D.; 43 *Green Street, Park Lane,* W.

Hooker, Sir Joseph Dalton, G.C.S.I., C.B., M.D., D.C.L., LL.D., F.R.S., F.L.S., F.G.S., F.R.G.S.; *The Camp, Sunningdale, Ascot.*

Hope, G. P.; *Havering Grange, Romford.*

Hopkinson, John, F.L.S., F.G.S., F.R.M.S., F.R.Met.Soc., Assoc.Inst.C.E., SECRETARY; *Weetwood, Watford.*

Huddersfield Naturalist and Photographic Society; *The Technical College, Huddersfield.*

Hull Public Libraries; *Hull.*

India, Geological Survey of; *Calcutta.*

Ireland, National Library of; *Kildare Street, Dublin.*

Irish, Royal, Academy; 19 *Dawson Street, Dublin.*

Jackson, B. Daydon, F.L.S., General Secretary of the Linnean Society; 21, *Cautley Avenue, Clapham Common,* S.W.

John Crerer Library; *Chicago, Ill., U.S.A.*

Jones, Albert H., F.E.S.; *Shrublands, Eltham.*

Junk, W.; 22 *Rathenowerstrasse, Berlin,* N.W. 5.

Justen, Frederick, F.L.S.; 37 *Soho Square,* W.

Kenrick, G. H., F.E.S.; *Whetstone, Somerset Road, Edgbaston, Birmingham.*

Kiel University Library; *Kiel, Germany.*

Kilmarnock Public Library and Museum; *Kilmarnock, N.B.*

King's Inn Library; *Dublin.*

Knight, H. H.; *Bank House, Llandovery.*

Laver, Henry, M.R.C.S.; 43 *Head Street, Colchester.*

Lebour, Miss Marie V., B.Sc.; *Radcliffe House, Corbridge,* R.S.O., *Northumberland.*

Leeds Philosophical and Literary Society; *The Museum, Leeds.*

Leeds Public Free Libraries; *Leeds.*

Leeds University Library; *Leeds.*

Leicester Free Public Library; *Wellington Street, Leicester.*

Lemann, F. C., F.E.S.; *Black Friars House, Plymouth.*

Lethbridge, Ambrose Y., F.E.S.; *Nordrach-on-Dee, Banchory,* R.S.O., *Kincardineshire.*

Linnean Society of London; *Burlington House, Piccadilly,* W.

Lister, Arthur, F.R.S., F.L.S.; *Sycamore House, Leytonstone,* N.E., *and High Cliff, Lyme Regis.*

Liverpool Athenæum; *Liverpool.*

Liverpool Free Public Libraries; *Liverpool.*

Liverpool Microscopical Society; *Royal Institution, Liverpool.*

Liverpool School of Tropical Medicine; *Exchange Buildings, Liverpool.*

London Institution; *Finsbury Circus,* E.C.

London Library; 12 *St. James's Square,* S.W.

Longstaff, G. B., M.D.; *Highlands, Putney Heath,* S.W.

Los Angeles Public Library; *California, U.S.A.*

Lyon Université Bibliothèque; *Lyons, France.*

McIntosh, W. Carmichael, M.D., LL.D., F.R.S.L.&E., F.L.S., Professor of Natural History, University of St. Andrews; 2 *Abbotsford Crescent, St. Andrews, N.B.*

McMillan, William Singer, F.L.S.; *Ardenholm, Maghull, Liverpool.*

Magdalen College; *Oxford.*

Manchester Literary and Philosophical Society; 36 *George Street, Manchester.*

Manchester Microscopical Society; 26 *Grosvenor Road, Whalley Range, Manchester.*

Manchester Public Free Libraries; *Manchester.*

Marlborough College Natural History Society; *Marlborough.*

Massey, W. H.; *Twyford,* R.S.O., *Berks.*

Meiklejohn, J. W. S., M.D., F.L.S.; 105 *Holland Road, Kensington,* W.

Melbourne Public Library; *Melbourne, Australia.*

Mennell, H. T., F.L.S.; 10 *St. Dunstan's Buildings, Great Tower Street,* E.C.

Michael, Albert D., F.L.S., F.Z.S., F.R.M.S., F.R.H.S., Vice-President; *The Warren, Studland, Wareham.*

Middlesbrough Free Libraries; *Middlesbrough.*

Mitchell Library; 21 *Miller Street, Glasgow.*

Moore, H.; 12 *Whiston Grove, Rotherham.*

Morgan, Ralph; 9 *Clifton Hill, Exeter.*

Munich Royal Library; *Munich, Germany.*

Murray, James; *Challenger Office, Villa Medusa, Boswell Road, Edinburgh; and Ardoch Nerston, East Kilbride, N.B.*

Muséum d'Histoire Naturelle; *Paris.*

Newcastle-upon-Tyne Literary and Philosophical Society; *Westgate Road, Newcastle-upon-Tyne.*

Newcastle-upon-Tyne Natural History Society; *Museum, Barras Bridge, Newcastle-upon-Tyne.*

Newcastle-upon-Tyne Public Library; *Newcastle-upon-Tyne.*

New South Wales, Public Library of; *Sydney, New South Wales.*

New South Wales, Royal Society of; *Sydney, N.S.W.*

Newstead, Robert, A.L.S., F.E.S., Hon.F.R.H.S.; *School of Tropical Medicine, The University, Liverpool.*

New York Botanical Garden; *Bronx Park, New York City, N.Y., U.S.A.*

New York Public Library; *New York, U.S.A.*

New York State Library; *Albany, N.Y., U.S.A.*

Noble, Sir Andrew, K.C.B., F.R.S.; *Jesmond Dene House, Newcastle-upon-Tyne.*

Norfolk and Norwich Library; *Norwich.*

Norman, The Rev. A. Merle, M.A., D.C.L., LL.D., F.R.S., F.L.S., Hon. Canon of Durham, Vice-President; *The Red House, Berkhamsted.*

Norwich Free Library; *Norwich.*

Nottingham Free Public Libraries; *Nottingham.*

OKamura, Prof. K.; 67 *Tansu-machi, Azabu, Tokyo, Japan.*

Ontario Agricultural College; *Guelph, Canada.*

Otago, University of; *Dunedin, New Zealand.*

Owens College (Christie Library); *Manchester.*

Paisley Philosophical Institution; 3 *County Place, Paisley.*

Peabody Institute; *Baltimore, Maryland, U.S.A.*

Perthshire Society of Natural Science; *Tay Street, Perth.*

Phené, J. S., LL.D., F.S.A.; 5 *Carlton Terrace, Oakley Street,* S.W.

Philadelphia Academy of Natural Sciences; *Philadelphia, Pa., U.S.A.*

Pickard-Cambridge, The Rev. O., M.A., F.R.S.; *Bloxworth Rectory, Wareham.*

Plowman, T.; *Nystuen Lodge, Bycullah Park, Enfield.*

Plymouth Institution; *Athenæum, Plymouth.*

Porter, R. H.; 7 *Princes Street, Cavendish Square,* W.

Portsmouth Free Public Library; *Town Hall, Portsmouth.*

Poulton, Edward B., M.A., Sc.D., LL.D., F.R.S., F.L.S., F.G.S., F.E.S., Hope Professor of Zoology, University of Oxford; *Wykeham House, Oxford.*

Power, Henry, M.B., F.R.C.S., F.L.S, F.Z.S.; *Bagdale Hall, Whitby.*

Preston Free Public Libraries and Museum; *Preston.*

Pye-Smith, P. H., M.D., B.A., F.R.C.P., F.R.S.; 48 *Brook Street, Cavendish Square,* W.

Quaritch, Bernard; 15, *Piccadilly,* W.

Queen's College; *Belfast.*

Queen's College; *Cork.*

Quekett Microscopical Club; 20 *Hanover Square,* W.

Radcliffe Library; *Museum, Oxford.*

Rashleigh, Evelyn William; *Stoketon, Saltash, Cornwall.*

Ripon, The Most Hon. the Marquis of, K.G., K.C.S.I., D.C.L., F.R.S., F.L.S., F.G.S., F.Z.S.; 9 *Chelsea Embankment,* S.W., *and Studley Royal, Ripon.*

Rotherham Naturalists' Society; *Rotherham.*

Royal Academy of Sciences; *Amsterdam.*

Royal Academy of Sciences; *Stockholm, Sweden.*

Royal College of Science; *Dublin.*

Royal Institution of Great Britain; *Albemarle Street,* W.

Royal Microscopical Society; 20 *Hanover Square,* W.

Royal Society; *Burlington House, Piccadilly,* W.

St. Albans Public Library; *St. Albans.*

St. Andrews University Library; *St. Andrews, N.B.*

St. Catharine's College; *Cambridge.*

Salford Free Museum and Libraries; *Peel Park, Salford, Manchester.*

Salisbury Microscopical Society; 14 *Wyndham Terrace, Salisbury.*

Scharff, R. F., Ph.D., B.Sc., F.L.S., F.Z.S.; *Tudor House, Dundrum,* R.S.O., *co. Dublin.*

Sears, R. S. Wilson; 1 *Lisson Grove, Marylebone,* N.W.

Sheffield Literary and Philosophical Society; *Leopold Street, Sheffield.*

Schmidle, Prof. W., Seminar-Director; *Meersburg-on-Bodensee, Baden, Germany.*

Schmidt, Max, Ph.D.; *Weg beim Täger, Gross Borstel, bei Hamburg.*

Scottish, Royal, Museum; *Edinburgh.*

Sidney-Sussex College; *Cambridge.*

Sion College Library; *Victoria Embankment,* E.C.

Soar, C. D.; 37 *Dryburgh Road, Putney,* S.W.

Somersetshire Archæological and Natural History Society; *The Castle, Taunton.*

Southport Free Library; *Southport.*

Spicer, Henry, B.A., F.L.S., F.G.S.; 14 *Aberdeen Park, Highbury,* N.

Sprague, T. B., M.A., LL.D.; 29 *Buckingham Terrace, Edinburgh.*

Stazione Zoologica; *Naples.*

Stechert, G. E.; 2 *Star Yard, Carey Street,* W.C.

Stoke Newington Public Libraries; *Church Street,* N.

Storey, J. E.; 26 *Grosvenor Road, Whalley Range, Manchester.*

Stubbins, J.; *Woodlands, Pool, Leeds.*

Sunderland Library and Literary Society; *Fawcett Street, Sunderland.*

Terry, Charles; *Foxhill Grove, Bath.*

Toronto, University of; *Toronto, Canada.*

Torquay Natural History Society; *Museum, Babbacombe Road, Torquay.*

Town, Miss; 4 *The Birklands, Babbacombe Road, Torquay.*

Trinity College; *Cambridge.*

Trinity College; *Dublin.*

Trondhjem, Royal Library of; *Trondhjem, Norway.*

Tunstall, Wilmot, F.E.S.; *Caerleon, Greenlaw Drive, Paisley, N.B.*

University College, London; *Gower Street,* W.C.

Upsala University Library; *Upsala, Sweden.*

Victoria Institute ; *Worcester.*

Walker, Alfred O., F.L.S., F.Z.S. ; *Ulcombe Place, Maidstone.*

Walsingham, The Right Hon. Lord, M.A., LL.D., F.R.S., F.L.S., F.Z.S., F.E.S., Vice-President ; *Merton Hall, Thetford.*

Warrington Municipal Museum ; *Warrington.*

Warwickshire Natural History and Archæological Society ; *Cliff Hill, Warwick.*

Watzlaff, Emil ; 98 *Sandy Lane, Chorlton-cum-Hardy, Manchester, and* 28 *Deansgate Arcade.*

Weg, Max ; 1, *Leplaystrass, Leipzig.*

Wesley, E. F., A.K.C. ; 28 *Essex Street, Strand,* W.C.

West Kent Natural History Society ; 42 *Shooter's Hill Road, Blackheath,* S.E.

Whittle, F. G. ; 3 *Marine Avenue, Southend-on-Sea.*

Wickes, W. D., F.L.S. ; 20 *Warrior Square, Southend-on-Sea.*

Wood, J. H., M.B. ; *Tarrington, Ledbury.*

Woodd-Smith, Miss B. M. ; 17 *Langland Gardens, Hampstead,* N.W.

Yale University Library ; *New Haven, U.S.A.*

Yorkshire Philosophical Society ; *Museum, York.*

Zoological Society of London ; 3 *Hanover Square,* W.

The Advocates' Library, Edinburgh ; the Bodleian Library, Oxford ; the British Museum ; Cambridge University Library ; and Trinity College, Dublin, entered in the List, receive the Society's publications in accordance with the Copyright Act.

GEOGRAPHICAL LIST OF THE SOCIETY.

(Beyond the limits of the London Postal District.)

GREAT BRITAIN AND IRELAND.

ENGLAND.

BERKSHIRE.

Ascot—Hooker, Sir J. D.
Newbury — Blackburne - Maze, W. P.
Twyford—Massey, W. H.
Wellington College—FitzGerald, Rev. H. P.
Windsor—Berens, A. A.

BUCKINGHAMSHIRE.

Slough—Bentley, R.

CAMBRIDGESHIRE.

Cambridge—Downing College.
——— Harmer, Dr. S. F.
——— Philosophical Library.
——— St. Catherine's College.
Cambridge—Sidney-Sussex College.
——— Trinity College.
——— University Library.

CHESHIRE.

Chester—Society of Natural Science.
Northwich—Hewitt, D. B.

CORNWALL.

Saltash—Rashleigh, E. W.
Truro—R. Inst. of Cornwall.

DERBYSHIRE.

Chatsworth—Devonshire, Duke of.
Derby — Free Library and Museum.

DEVONSHIRE.

Exeter—Brokenshire, F. R.
——— Morgan, R.
Lynmouth—Briggs, C. A.
——— Briggs, T. H.
Newton Abbot—Bourne, T. W.
Plymouth—Crawshay, L. R.
——— Lemann, F. C.
——— Plymouth Institution.
Tavistock—Freeman, F. F.
Torquay—Natural History Society.

DORSETSHIRE.

Lyme Regis—Lister, A.
Wareham—Michael, A. D.
Wareham—Pickard-Cambridge, Rev. O. P.

DURHAM.

Sunderland—Library and Literary Society.

ESSEX.

Colchester—Laver, H.
Romford—Hope, G.
Saffron Walden—Gibson, Miss.
Southend—Whittle, F. G.
Southend—Wickes, W. D.
Stanford-le-Hope — Burrows, Rev. C. R. N.
Woodford—Harrison, A.

GLOUCESTERSHIRE.

Bristol—Museum.
——— Naturalists' Society.
——— Public Library.
Cheltenham — Natural Science Society.

HAMPSHIRE.

Bournemouth—Carlyon, T. A.
Portsmouth—Free Public Library.

HEREFORDSHIRE.

Ledbury—Wood, J. H.

HERTFORDSHIRE.

Berkhamsted — Norman, Rev. A. M.
Hertford—Haileybury College.
St. Albans—Gibbs, A. E.
——— Herts County Museum.
——— Public Library.
Waltham Cross—Bowles, E. A.
Ware—Croft, R. B.
Watford—Hertfordshire Natural History Society.
——— Hopkinson, J.

KENT.

Bromley—Naturalists' Society.
Canterbury—East Kent Natural History Society.
Eltham—Jones, A. H.
Farnborough—Avebury, Lord.
Folkestone—Free Public Library and Museum.
Maidstone—Walker, A. O.

LANCASHIRE.

Barrow-in-Furness—Public Library.
Garstang—Brockholes, Mrs. F. J.
Liverpool—Bootle Free Library.
——— Free Public Libraries.
——— Liverpool Athenæum.
——— Macmillan, W. S.
——— Microscopical Society.
——— Newstead, R.
——— School of Tropical Medicine.
Manchester—Chapman, E.
——— Literary and Philosophical Society.
Manchester—Microscopical Society.
——— Owens College.
——— Public Free Libraries.
——— Salford Free Museum and Libraries.
——— Storey, J. E.
——— Watzlaff, E.
Preston—Free Public Libraries and Museum.
St. Helens—Cotton, J.
Southport—Free Library.
Warrington — Municipal Museum.

LEICESTERSHIRE.

Leicester—Free Public Library.

MIDDLESEX.

Enfield—Plowman, T.

NORFOLK.

Norwich—Foster, C.
——— Norfolk and Norwich Library.
Norwich—Free Library.
Thetford—Walsingham, Lord.

NORTHUMBERLAND.

Corbridge—Lebour, Miss M. V.
Newcastle-upon-Tyne—Armstrong College.
——— Literary and Philosophical Society.
Newcastle-upon-Tyne—Noble, Sir A.
——— Northumberland and Durham Natural History Society.
——— Public Library.

NOTTINGHAMSHIRE.

Nottingham—Free Public Libraries.

OXFORDSHIRE.

Oxford—Bodleian Library.
——— Magdalen College.
Oxford—Poulton, Prof. E. B.
——— Radcliffe Library.

SOMERSETSHIRE.

Taunton—Somersetshire Natural History Society.

STAFFORDSHIRE.

Stone—Bostock, E. D.

SURREY.

Croydon—Dickinson, W.
——— Public Libraries.
Godalming—Eastwood, J. E.
Reigate—Chapman, Dr. T. A.

SUSSEX.

Bognor—Fletcher, W. H. B.
Brighton—Natural History Society.
Hastings—Bloomfield, Rev. E. N.
Hastings—Butterfield, W. R.
Horsham—Godman, Dr. F. D.
Pulborough—Harley, Dr. J.

WARWICKSHIRE.

Birmingham—Bethune-Baker, G. T.
——— Free Libraries.
Birmingham—Kenrick, G. H.
Warwick—Natural History Society.

WESTMORELAND.

Windermere—Gannett, F. W.

WILTSHIRE.

Marlborough—College Natural History Society.
Salisbury—Microscopical Society.

WORCESTERSHIRE.

Worcester—Victoria Institute.

YORKSHIRE.

Bradford—Natural History and Microscopical Society.
Halifax—Fielding, C.
Halifax—Public Library.
Huddersfield—Naturalist and Photographic Society.

YORKSHIRE—*continued.*

Hull—Public Libraries.
Leeds—Gascoigne, Major F.
——— Philosophical Society.
——— Public Free Libraries.
——— Stubbins, J.
——— University Library.
Middlesbrough—Free Libraries.
Ripon—Ripon, Marquis of.
Rotherham—Moore, H.
——— Naturalists' Society.
Sheffield—Brady, Dr. G. S.
——— Eliot, Sir C.
——— Literary and Philosophical Society.
Tadcaster—Ash, Rev. C. D.
Wakefield—Binks, Mrs. I.
Whitby—Power, H.
York—Yorkshire Philosophical Society.

WALES.

CARMARTHENSHIRE.

Llandovery—Knight, H. H.

GLAMORGANSHIRE.

Cardiff—Free Libraries.

MONTGOMERYSHIRE.

Machynlleth—Campbell, F. M.

SCOTLAND.

ABERDEENSHIRE.

Aberdeen—University Library.

AYRSHIRE.

Kilmarnock—Public Library and Museum.

EDINBURGHSHIRE.

Edinburgh—Advocates' Library.
——— Crawford, W. C.
——— Davies, Dr. A. E.
——— Murray, J.
——— Public Library.
Edinburgh—Royal Scottish Museum.
——— Royal Society.
——— Sprague, Dr. T. B.
——— University Library.

FIFESHIRE.

St. Andrews—McIntosh, Prof. W. C.
St. Andrews—University Library.

HADDINGTONSHIRE.

Prestonkirk—Buchan-Hepburn, Sir A.

KINCARDINESHIRE.

Banchory—Lethbridge, A. Y.

LANARKSHIRE.

East Kilbride—Murray, J.
Glasgow—Cleland, Prof. J.
——— Mitchell Library.
Glasgow—Natural History Soc.
——— Royal Philosophical Soc.
——— University Library.

PERTHSHIRE.

Perth—Perthshire Society of Natural Science.

RENFREWSHIRE.

Paisley—Philosophical Institution.

Paisley—Tunstall, W.

IRELAND.

ANTRIM.

Belfast—Belfast Library.

Belfast—Queen's College.

CORK.

Cork—Queen's College.

DUBLIN.

Dublin—King's Inn Library.
——— National Library of Ireland.
——— Royal College of Science.

Dublin—Royal Dublin Society.
——— Royal Irish Academy.
——— Trinity College.

Dundrum—Scharff, Dr. R. F.

CHANNEL ISLANDS.

Guernsey—Guille-Allès Library.

BRITISH POSSESSIONS.

AFRICA, SOUTH.

CAPE COLONY.

Grahamstown—Albany Museum.

AUSTRALIA.

NEW SOUTH WALES.

Sydney—Australian Museum.
——— Public Library of New South Wales.

Sydney—Royal Society of New South Wales.

SOUTH AUSTRALIA.

Adelaide—Public Library.

VICTORIA.

Melbourne—Hardy, A. D.

Melbourne—Public Library.

WESTERN AUSTRALIA.

South Perth—Giles, H. M.

CANADA.

ONTARIO.

Guelph—Ontario Agricultural College.

Toronto—University.

CEYLON.

Peradeniya—Green, E. E.

INDIA.

Calcutta—Geological Survey of India.

NEW ZEALAND.

Christchurch—Philosophical Institution of Canterbury.

Dunedin—University of Otago.

FOREIGN COUNTRIES.

AMERICA, UNITED STATES OF.

CALIFORNIA.

Los Angeles—Public Library.

COLUMBIA, DISTRICT OF.

Washington—Library of Congress.

ILLINOIS.

Chicago—John Crerer Library.

Chicago—University Library.

——— Public Library.

MARYLAND.

Baltimore—Peabody Institute.

MASSACHUSETTS.

Boston—Public Library.

Cambridge—Harvard Museum of Comparative Zoology.

——— Society of Natural History.

MICHIGAN.

Detroit—Public Library.

NEW HAVEN.

Yale—University Library.

NEW YORK.

Albany—New York State Library.

Buffalo—Grosvenor Public Library.

Ithaca—Cornell University.

New York—Botanical Garden.

——— Public Library.

PENNSYLVANIA.

Philadelphia—Academy of Natural Sciences.

AUSTRIA.

Vienna—Gerold and Co.

BELGIUM.

Brussels—National Library.

FRANCE.

Lyons—Lyon Université Bibliothèque.

Paris—Bibliothèque Nationale.

Paris—Institut de France.

——— Muséum d'Histoire Naturelle.

GERMANY.

Baden—Schmidle, Prof. W.
Berlin—Dames, F. L.
——— Friedländer & Sohn.
——— Junk, W.
——— Royal Library.
——— RoyalZoologicalMuseum.
Breslau—University Library.
Frankfort—Baer & Co.
Göttingen—University Library.
Hamburg—Schmidt, Dr. M
Heidelberg—University Library.
Kiel—University Library.
Leipzig—Weg, M.
Munich—Royal Library.

ITALY.

Naples—Stazione Zoologica.

JAPAN.

Tokyo—OKamura, Prof. K.

NETHERLANDS.

Amsterdam—Royal Academy of Sciences.

NORWAY.

Bergen—Museums Bibliotek.
Christiana—University.
Trondhjem—Royal Library.

SWEDEN.

Stockholm—Royal Academy of Sciences.
Upsala—University Library.

SWITZERLAND.

Berne—Natural History Museum.

LIST OF THE PUBLICATIONS

OF THE

RAY SOCIETY.

For the First Year, 1844.

1. Reports on the Progress of Zoology and Botany, 1841, 1842. viii + 496 + xx pp. 8vo. 1845.

The State of Zoology in Europe, as regards the Vertebrata. By C. L. Bonaparte. Transl. by H. E. Strickland. pp. 1–44.

The Progress of Zoology in 1842. Transl. from the German by W. B. Macdonald. pp. 1–348.

The Progress of Physiological Botany in 1841. By H. F. Link. Transl. by Edwin Lankester. pp. 1–104. Index, pp. i–xx.

2. A Monograph of the British Nudibranchiate Mollusca. By Joshua Alder and Albany Hancock. Part I. x + 20 pp., 10 plates. Folio. 1845.

3. Memorials of John Ray, consisting of his Life by Dr. Derham ; . . . with his Itineraries, etc. Edited by Edwin Lankester. xii + 220 pp. 8vo. 1846.

For the Second Year, 1845.

4. On the Alternation of Generations. By J. J. S. Steenstrup. Transl. from the German version of C. H. Lorenzen by George Busk. viii + 132 pp., 3 plates. 8vo. 1845.

5. A Monograph of the British Nudibranchiate Mollusca. By Joshua Alder and Albany Hancock. Part II. iv + 34 pp., 13 plates. Folio. 1846.

6. Reports and Papers on Botany. viii + 494 pp., 7 plates. 8vo. 1846.

On the Morphology of the Coniferæ. By J. J. Zuccarini. Transl. by George Busk. pp. 1–54, 441–444, pls. i–v.

Report on Botanical Geography, 1842. By A. Grisebach. Transl. by W. B. Macdonald. pp. 55–212.

Memoir on the Nuclei, Formation, and Growth of Vegetable Cells. By Carl Nägeli. Transl. by Arthur Henfrey. pp. 213–292, 445–459, pls. vi, vii.

Report on Physiological Botany, 1842 and 1843. By H. F. Link. Transl. by J. Hudson. pp. 293–440. Index pp. 461–494.

For the third Year, 1846.

7. Outlines of the Geography of Plants. By F. J. F. Meyen. Transl. by Margaret Johnston. x + 422 pp., 1 plate. 8vo. 1846.

8. The Organization of Trilobites. By Hermann Burmeister. Edited by Thomas Bell and Edwabd Forbes. xii + 136 pp., 6 plates. Folio. 1846.

9. A Monograph of the British Nudibranchiate Mollusca. By Joshua Alder and Albany Hancock. Part III. iv + 30 pp., 12 plates. Folio. 1847.

For the Fourth Year, 1847.

10. Elements of Physiophilosophy. By Lorenz Oken. From the German by Alfred Tulk. xx + 666 pp. 8vo. 1847.

11. Reports on Zoology for 1843, 1844. Transl. from the German by George Busk, Alfred Tulk, and A. H. Haliday. viii + 596 pp. 8vo. 1847.

Progress of Zoology in 1843. pp. 1–232.
„ „ 1844. pp. 233–564.
Index, pp. 565–596.

12. A Monograph of the British Naked-eyed Medusæ. By Edward Forbes. viii + 104 pp., 13 plates. Folio. 1848.

For the Fifth Year, 1848.

13. Bibliographia Zoologiæ et Geologiæ. A General Catalogue of all Books, Tracts, and Memoirs on Zoology and Geology. By Louis Agassiz. Edited by H. E. Strickland. Vol. I. Periodicals, and A–B. xxvi + 506 pp. 8vo. 1848.

14. The Correspondence of John Ray. Edited by Edwin Lankester. xvi + 502 pp., 2 plates. 8vo. 1848.

15. A Monograph of the British Nudibranchiate Mollusca. By Joshua Alder and Albany Hancock. Part IV. iv + 28 pp., 12 plates. Folio. 1848.

For the Sixth Year, 1849.

16. Reports and Papers on Botany. Edited by Arthur Henfrey. viii + 514 pp., 3 plates. 8vo. 1849.

On the Structure of the Palm-stem. By H. von Mohl. pp. 1–92, 495, pl. i.

On the Nuclei, Formation, and Growth of Vegetable Cells. By Carl Nägeli. Part II. pp. 93–158, 495–502, pls. ii, iii.

On the Utricular Structures in the Contents of Cells. By Carl Nägeli. pp. 159–190.

Report on Physiological Botany for 1844 and 1845. By H. T. Link. pp. 191–314.

Report on Geographical Botany for 1844. By A. Grisebach. pp. 315–414.

Report on Geographical and Systematic Botany for 1845. By A. Grisebach. pp. 415–494.

17. The Natural History of the British Entomostraca. By W. Baird. viii + 364 pp., 36 plates. 8vo. 1850.

For the Seventh Year, 1850.

18. Bibliographia Zoologiæ et Geologiæ. A General Catalogue of all Books, Tracts, and Memoirs on Zoology and Geology. By Louis Agassiz. Edited by H. E. Strickland. Vol. II. C–F. iv + 492 pp. 8vo. 1850.

19. A Monograph of the British Nudibranchiate Mollusca. By Joshua Alder and Albany Hancock. Part V. iv + 62 pp., 16 plates. Folio. 1851.

For the Eighth Year, 1851.

20. The British Species of Angiocarpous Lichens, elucidated by their Sporidia. By the Rev. W. A. Leighton. vi + 102 pp., 30 plates. 8vo. 1851.

21. A Monograph of the Sub-class Cirripedia. By Charles Darwin. The Lepadidæ, or Pedunculated Cirripedes. xii + 400 pp., 10 plates. 8vo. 1851.

For the Ninth Year, 1852.

22. Bibliographia Zoologiæ et Geologiæ. A General Catalogue of all Books, Tracts, and Memoirs on Zoology and Geology. By Louis Agassiz. Edited by H. E. Strickland. Vol. III. G–M. vi + 658 pp. 8vo. 1852.

23. A Monograph of the British Nudibranchiate Mollusca. By Joshua Alder and Albany Hancock. Part VI. iv + 62 pp., 12 plates. Folio. 1852.

For the Tenth Year, 1853.

24. Botanical and Physiological Memoirs. Edited by Arthur Henfrey. xvi + 568 pp., 6 plates. 8vo. 1853.

The Phenomenon of Rejuvenescence in Nature. By Alexander Braun. pp. vii–xxvi, 1–342, pls. i–v.

The Animal Nature of Diatomeæ. By G. Menighini. pp. 343–514.

The Natural History of *Protococcus pluvialis*. By Ferdinand Cohn. pp. 515–564, pl. vi.

25. A Monograph of the Sub-class Cirripedia. By Charles Darwin. The Balanidæ, the Verrucidæ, etc. viii + 684 pp., 30 plates. 8vo. 1854.

For the Eleventh Year, 1854.

26. Bibliographia Zoologiæ et Geologiæ. A General Catalogue of all Books, Tracts, and Memoirs on Zoology and Geology. By Louis Agassiz. Edited by H. E. Strickland. Vol. IV. N–Z. vi + 604 pp. 8vo. 1854.

For the Twelfth Year, 1855.

27. A Monograph of the British Nudibranchiate Mollusca. By Joshua Alder and Albany Hancock. Part VII. vi + 54 + 40 + xlvi pp., 9 plates. Folio. 1855.

For the Thirteenth Year, 1856.

28. A Monograph of the Fresh-water Polyzoa, including all the known species, both British and Foreign. By George James Allman. viii + 122 + 22 pp., 11 plates. Folio. 1856 [1857].

For the Fourteenth Year, 1857.

29. The Recent Foraminifera of Great Britain. By William Crawford Williamson. xx + 108 pp., 7 plates. Folio. 1858.

For the Fifteenth Year, 1858.

30. The Oceanic Hydrozoa; a Description of the Calycophoridæ and Physophoridæ. . . . By Thomas Henry Huxley. x + 144 + 24 pp., 12 plates. Folio. 1859.

For the Sixteenth Year, 1859.

31. A History of the Spiders of Great Britain and Ireland. By John Blackwall. [Part I.] vi + 174 + 24 pp., 12 plates. Folio. 1861.

For the Seventeenth Year, 1860.

32. Introduction to the Study of the Foraminifera. By William B. Carpenter, assisted by William K. Parker and T. Rupert Jones. xxii + 320 + 44 pp., 22 plates. Folio. 1862.

For the Eighteenth Year, 1861.

33. On the Germination, Development, and Fructification of the Higher Cryptogamia, and on the Fructification of the Coniferæ. By Wilhelm Hofmeister. Transl. by Frederick Currey. xviii + 506 pp., 65 plates. 8vo. 1862.

For the Nineteenth Year, 1862.

34. A History of the Spiders of Great Britain and Ireland. By John Blackwall. Part II. iv + 210 (175–384) + 34 pp., 17 plates. Folio. 1864.

For the Twentieth Year, 1863.

35. The Reptiles of British India. By Albert C. L. G. Gunther. xxviii + 452 pp., 26 plates. Folio. 1864.

For the Twenty-first Year, 1864.

36. A Monograph of the British Spongiadæ. By J. S. Bowerbank. Vol. I. xx + 290 pp., 37 plates. 8vo. 1864.

For the Twenty-second Year, 1865.

37. The British Hemiptera. Vol. I. Hemiptera-Heteroptera. By John William Douglas and John Scott. xii + 628 + 42 pp., 21 plates. 8vo. 1865.

38. A Monograph of the British Spongiadæ. By J. S. Bowerbank. Vol. II. xx + 388 pp. 8vo. 1866.

For the Twenty-third Year, 1866.

39. The Miscellaneous Botanical Works of Robert Brown. [Edited by John J. Bennett.] Vol. I, containing I, Geographico-botanical, and II, Structural and Physiological Memoirs. viii + 612 pp. 8vo. 1866.

40. Recent Memoirs on the Cetacea. Edited by William Henry Flower. xii + 312 pp., 6 plates. Folio. 1866.

I. On the Greenland, Right-Whale. By D. F. Eschricht and J. Reinhardt. pp. 1–150, pls. i–vi.

II. On the Species of the Genus *Orca* inhabiting the Northern Seas. By D. F. Eschricht. pp. 151–188.

III. *Pseudorca crassidens*, a Cetacean hitherto unknown in the Danish Fauna. By J. Reinhardt. pp. 189–218.

IV. Synopsis of the Cretaceous Mammalia of Scandinavia (Norway and Sweden). By W. Lilljeborg. pp. 219–310.

41. Nitzsch's Pterylography, translated from the German. Edited by Philip Lutley Sclater. xii + 182 pp., 10 plates. Folio. 1867.

For the Twenty-fourth Year, 1867.

42. A Monograph on the Structure and Development of the Shoulder-girdle and Sternum in the Vertebrata. By W. Kitchen Parker. xii + 240 + 60 pp., 30 plates. Folio. 1868.

43. The Miscellaneous Botanical Works of Robert Brown. [Edited by John J. Bennett.] Vol. II, containing III, Systematic Memoirs, and IV, Contributions to Systematic Works. viii + 780 pp. 8vo. 1868.

For the Twenty-fifth Year, 1868.

44. The Miscellaneous Botanical Works of Robert Brown. [Edited by John J. Bennett.] Vol. III. Atlas of Plates. iv + 16 pp., 38 plates. Folio. 1868.

45. Vegetable Teratology, an Account of the Principal Deviations from the Usual Structure of Plants. By Maxwell T. Masters. With numerous illustrations by E. M. Williams. xxxviii + 534 pages. 8vo. 1869.

For the Twenty-sixth Year, 1869.

46. A Monograph of the Gymnoblastic or Tubularian Hydroids. By George James Allman. Part I, the Hydroida in General. xxii + 154 + 24 pp., 12 plates. Folio. 1871.

For the Twenty-seventh Year, 1870.

47. A Monograph of the Gymnoblastic or Tubularian Hydroids. By George James Allman. Conclusion of Part I, and Part II, containing descriptions of the Genera and Species of the Gymnoblastea. iv + 2 (xxiii, xxiv) + 296 (155–450) + 22 pp., 11 plates (xiii–xxiii). Folio. 1872.

For the Twenty-eighth Year, 1871.

48. Monograph of the Collembola and Thysanura. By Sir John Lubbock. x + 276 pp., 78 plates. 8vo. 1873.

For the Twenty-ninth Year, 1872.

49. A Monograph of the British Annelids. By W. C. McIntosh. Part I. The Nemertians. xiv + 96 + 20 pp., 10 plates. Folio. 1873.

For the Thirtieth Year, 1873.

50. A Monograph of the British Annelids. By W. C. McIntosh. Part I continued. The Nemertians. iv + 122 (97–214, 213 *a*–*d*) + 26 pp., 13 plates (xi–xxiii). Folio. 1874.

For the Thirty-first Year, 1874.

51. A Monograph of the British Spongiadæ. By J. S. Bowerbank. Vol. III. xxviii + 368 pp., 92 plates. 8vo. 1874.

For the Thirty-second Year, 1875.

52. A Monograph of the British Aphides. By George Bowdler Buckton. Vol. I. x + 194 + 78 pp., 42 plates (A–C, i–xxxviii, iv bis). 8vo. 1876.

For the Thirty-third Year, 1876.

53. A Monograph of the Free and Semi-parasitic Copepoda of the British Islands. By G. Stewardson Brady. Vol. I. iv + 148 + 72 pp., 36 plates (1–33, 10A, 24A, 24B). 8vo. 1878.

For the Thirty-fourth Year, 1877.

54. A Monograph of the British Aphides. By George Bowdler Buckton. Vol. II. iv + 176 + 100 pp., 50 plates (xxxix–lxxxvi, li bis, lxix bis). 8vo. 1879.

For the Thirty-fifth Year, 1878.

55. A Monograph of the Free and Semi-parasitic Copepoda of the British Islands. By G. Stewardson Brady. Vol. II. iv + 182 + 98 pp., 49 plates (34–82). 8vo. 1880.

For the Thirty-sixth Year, 1879.

56. A Monograph of the Free and Semi-parasitic Copepoda of the British Islands. By G. Stewardson Brady. Vol. III. iv + 84 + 22 pp., 11 plates (83–93). 8vo. 1880.

57. A Monograph of the British Spongiadæ. By the late J. S. Bowerbank. Vol. IV (Supplementary). Edited, with additions, by the Rev. A. M. Norman. xviii + 250 + 34 pp., 17 plates. 8vo. 1882.

For the Thirty-seventh Year, 1880.

58. A Monograph of the British Aphides. By George Bowdler Buckton. Vol. III. vi + 142 + 56 pp., 28 plates (lxxxvii–cxiv). 8vo. 1881.

For the Thirty-eighth Year, 1881.

59. A Monograph of the British Phytophagous Hymenoptera. By Peter Cameron. Vol. I. viii + 340 + 42 pp., 21 plates. 8vo. 1882.

For the Thirty-ninth Year, 1882.

60. A Monograph of the British Aphides. By George Bowdler Buckton. Vol. IV. x + 228 + 62 pp., 27 plates (D–I, cxiv bis, cxv–cxxxiv). 8vo. 1883.

For the Fortieth Year, 1883.

61. British Oribatidæ. By Albert D. Michael. Vol. I. xii + 336 + 62 pp., 31 plates (i–xxiv, A–G). 8vo. 1884.

For the Forty-first Year, 1884.

62. A Monograph of the British Phytophagous Hymenoptera. By Peter Cameron. Vol. II. vi + 234 + 54 pp., 27 plates. 8vo. 1885.

For the Forty-second Year, 1885.

63. The Larvæ of the British Butterflies and Moths. By the late William Buckler. Vol. I. (The Butterflies.) Edited by H. T. Stainton. xvi + 202 + 34 pp., 17 plates. 8vo. 1886.

For the Forty-third Year, 1886.

64. The Larvæ of the British Butterflies and Moths. By the late William Buckler. Vol. II. (The Sphinges or Hawk-moths and part of the Bombyces.) Edited by H. T. Stainton. xii + 172 + 36 pp., 18 plates (xviii–xxxv). 8vo. 1887.

For the Forty-fourth Year, 1887.

65. British Oribatidæ. By Albert D Michael. Vol. II. xii + 322 (337–658) + 62 pp., 31 plates (xxv–liv, xlviia). 8vo. 1888.

For the Forty-fifth Year, 1888.

66. The Larvæ of the British Butterflies and Moths. By the late William Buckler. Vol. III. (The concluding portion of the Bombyces.) Edited by H. T. Stainton. xvi + 80 + 36 pp., 18 plates (xxxvi–liii). 8vo. 1889.

For the Forty-sixth Year, 1889.

67. A Monograph of the British Phytophagous Hymenoptera. By Peter Cameron. Vol. III. vi + 274 + 34 pp., 17 plates. 8vo. 1890.

For the Forty-seventh Year, 1890.

68. The Larvæ of the British Butterflies and Moths. By the late William Buckler. Vol. IV. (The first portion of the Noctuæ.) Edited by H. T. Stainton. xii + 116 + 32 pp., 16 plates (liv–lxix). 8vo. 1891.

For the Forty-eighth Year, 1891.

69. The Larvæ of the British Butterflies and Moths. By the late William Buckler. Vol. V. (The second portion of the Noctuæ.) Edited (in part) by the late H. T. Stainton. xii + 90 + 34 pp., 17 plates (lxx–lxxxvi). 8vo. 1893.

For the Forty-ninth Year, 1892.

70. A Monograph of the British Phytophagous Hymenoptera. By Peter Cameron. Vol. IV. vi + 248 + 38 pp., 19 plates. 8vo. 1893.

For the Fiftieth Year, 1893.

71. The Larvæ of the British Butterflies and Moths. By the late William Buckler. Vol. VI. (The third and concluding portion of the Noctuæ.) Edited by Geo. T. Porritt. xii + 142 + 38 pp., 19 plates (lxxxvii–cv). 8vo. 1895.

For the Fifty-first Year, 1894.

72. The Larvæ of the British Butterflies and Moths. By the late William Buckler. Vol. VII. (The first portion of the Geometræ.) Edited by Geo. T. Porritt. xvi + 176 + 44 pp., 22 plates (cvi–cxxvii). 8vo. 1897.

For the Fifty-second Year, 1895.

73. The Larvæ of the British Butterflies and Moths. By the late William Buckler. Vol. VIII. (The concluding portion of the Geometræ.) Edited by Geo. T. Porritt. xii + 120 + 70 pp., 20 plates (cxxviii–cxlvii). 8vo. 1899.

For the Fifty-third Year, 1896.

74. The Tailless Batrachians of Europe. By G. A. Boulenger. Part I. viii + 210 pp., 10 plates. 8vo. 1897.

For the Fifty-fourth Year, 1897.

75. The Tailless Batrachians of Europe. By G. A. Boulenger. Part II. ii + 166 (211–376) pp., 14 plates (xi–xxiv). 8vo. 1898.

For the Fifty-fifth Year, 1898.

76. A Monograph of the British Annelids. By William Carmichael McIntosh. Part II. Polychæta. Amphinomidæ to Sigalionidæ. x + 228 (215–442) + 40 pp., 20 plates (xxiv–xlii, xxvia). Folio. 1900.

For the Fifty-sixth Year, 1899.

77. The Larvæ of the British Butterflies and Moths. By the late William Buckler. Vol. IX. (The Deltoides, Pyrales, Crambites, Tertrices, Tineæ, and Pterophori.) Edited by Geo. T. Porritt. xviii + 420 + 34 pp., 17 plates (cxlviii–clxiv). 8vo. 1901.

For the Fifty-seventh Year, 1900.

78. Monograph of the Coccidæ of the British Isles. By Robert Newstead. Vol. I. xii + 220 + 78 pp., 39 plates (a–e, i–xxxiv). 8vo. 1901.

For the Fifty-eighth Year, 1901.

79. British Tyroglyphidæ. By Albert D. Michael. Vol. I. xvi + 294 + 44 pp., 22 plates (a–c, i–xix). 8vo. 1901.

For the Fifty-ninth Year, 1902.

80. Monograph of the Coccidæ of the British Isles. By Robert Newstead. Vol. II. viii + 270 + 84 pp., 42 plates (f, xxxv–lxxv). 8vo. 1903.

For the Sixtieth Year, 1903.

81. British Tyroglyphidæ. By Albert D. Michael. Vol. II. xii + 184 + 40 pp., 20 plates (xx–xxxix). 8vo. 1903.

For the Sixty-first Year, 1904.

82. A Monograph of the British Desmidiaceæ. By W. West and G. S. West. Vol. I. xxxvi + 224 + 64 pp., 32 plates. 8vo. 1904.

83. The British Tunicata. By the late Joshua Alder and the late Albany Hancock. Edited by John Hopkinson. Vol. I. With a history of the work by the Rev. A. M. Norman. xvi + 148 + 40 pp., 20 plates, and frontispiece. 8vo. 1905.

For the Sixty-second Year, 1905.

84. A Monograph of the British Desmidiaceæ. By W. West and G. S. West. Vol. II. x + 206 + 64 pp., 32 plates (xxxiii–lxiv). 8vo. 1905.

85. The British Freshwater Rhizopoda and Heliozoa. By James Cash, assisted by John Hopkinson. Vol. I. The Rhizopoda, Part I. x + 150 + 32 pp., 16 plates. 8vo. 1905.

In Course of Publication.

The British Annelids. By Prof. W. C. McIntosh.

The British Desmidiaceæ. By W. West and Prof. G. S. West.

The British Freshwater Rhizopoda and Heliozoa. By James Cash.

The British Tunicata. By the late Joshua Alder and the late Albany Hancock.

Preparing for Publication.

The British Centipedes and Millepedes. By Wilfred Mark Webb.

The British Characeæ. By Henry and James Groves.

The British Copepoda parasitic upon Fishes. By Dr. Thomas Scott and Andrew Scott.

The British Ixodoidea. By W. F. Cooper and L. E. Robinson.

The British Nudibranchiate Mollusca. By the late Joshua Alder and the late Albany Hancock. Part 8. Edited by Sir Charles Eliot.

The Earwigs of the World. By Malcolm Burr.

PRINTED BY ADLARD AND SON, LONDON AND DORKING.

596 2 A361 V02
ALDER J THE BRITISH TUNICATA

INSERT BOOK
MASTER CARD
FACE UP IN
FRONT SLOT
OF S.R. PUNCH

MASTER CARD

GLOBE 901144-D

UNIVERSITY OF ARIZO
LIBRARY